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CIVIL ENGINEERING.

On the Steam Jet, as a Ventilating Power. By NICHOLAS WOOD, F. G. S., President of the North of England Institute of Mining Engineers.*

The steam jet was first proposed as a ventilating power by Mr. Goldsworthy Gurney, in 1835, to a "Committee of the House of Commons on Accidents in Coal Mines." His proposition to the Committee was "a common boiler, furnished with a small tube, leading to the shaft, and pointing either up or down, as you desire the current to be driven, placed in a cylinder, the size of which must be governed by the quantity of steam used, or the quantity of current you intend to make. A very small jet of steam, at 60 lbs. to the inch, of about the size of a goose quill, will dislodge 350,000 cubic feet of air in an hour."

Again, in 1839, Mr. Gurney proposed to the South Shields Committee steam jets as a ventilating power, and sent drawings of the mode of applying the jets, which may be seen in their Transactions. Mr. Gurney then proposed that the boiler should be placed at the top of the pit, and the jets placed within it, about 20 or 30 feet down. And he says, "16 jets of $\frac{5}{16}$ths area, fed by steam of 40 lbs. per square inch, placed not less than 30 feet in the upcast, and equally divided through its sectional area, would produce a current of air, at the rate of 20 miles per hour, in a shaft 41 feet area, or 72,160 cubic feet per minute."

In 1849, Mr. Gurney again brought forward, before a Committee of the House of Lords, the steam jet; and lastly, in 1852, before a Committee of the House of Commons. With regard to the mode of applying the jet, Mr. Gurney, in answer to Question 433, Lords' Committee, 1849, "Is it desirable to place them near the surface, or near the bottom?" said, "Save the rarefaction, and the little power given out by the heat of

* From the London Civil Engineer and Architect's Journal, December, 1853.

the steam, in the shape of heat, and lightening the column, it does not matter where it is placed; it is not worth consideration." And in answer to Question 434, says, "It is not worth calculation." And he mentions an experiment at Seaton Delaval, making the quantity of air due to the rarefaction of the steam only 6000 cubic feet per minute, the quantity of the steam jet being 33,000. He therefore assumes the ratio to be as 6 is to 33.

Notwithstanding the very flattering estimate of the powers of the steam jet, it does not appear that it was used at any of the collieries in this district until Mr. Forster adopted it, at the Seaton Delaval Colliery, in 1849, and, since then, it has been tried in some other collieries. It has always appeared to me, that great part of the difference of opinion which has arisen as to the utility and efficiency of the steam jet has been occasioned from a clear distinction not having been made between the effect arising from the rarefaction of the air in the upcast shaft, by the heat of the engine fires, and by the heat given out by the steam (when the boilers are placed at the bottom of the pit), and the mechanical effect, or propulsive power, of the steam jet, as a moving force, in producing ventilation. It is true, Mr. Gurney attributes little or no effect to the aids, which, as previously noticed, he says are "not worth consideration," but attributes almost the entire power of the steam jet, as a propulsive force.

We shall not, however, be able thoroughly to estimate the power and efficiency of the steam jet, unless we separate and determine by experiment, or in some other conclusive manner, what is due to each of the mechanical forces which contribute to form the entire power of the jet as a means of ventilation, in the different modes in which it has been or may be applied. In order to accomplish these, we shall have to consider separately, and subject to experiment:—

1st. The effect of the engine fires as regards rarefaction in the upcast shaft, when the boilers and jets are placed at the bottom of the pit.

2d. The effect of the rarefaction, and of the column of steam in the upcast shaft, when the jets are placed at the bottom of the pit, whether the steam is obtained from boilers at the bottom of the pit, or is conveyed by pipes from boilers placed on the surface.

3d. The mechanical effect of the jets alone, as a propulsive force, to produce ventilation.

In the consideration of the first of these, little explanation is required. If a fire is employed to pass underneath and around the boiler, to convert water into steam, (apart from the consideration of the effect of that portion of the heat communicated to the steam, and again given out in its passage up the shaft, which comes under the second head of the inquiries,) the surplus heat, passing into the shaft, acts upon the air in the upcast shaft in precisely the same manner, so far as regards the quantity of heat so communicated, as if such heat proceeded from a furnace, viz.: by rarefying the air in the shaft, and producing an amount of ventilation corresponding with the quantity of heat so passing off.

It is, however, worthy of remark, and it is a circumstance of some importance in this inquiry, that a considerable diminution of effect is sustained if such fires are of the ordinary description; the combustion of the coal in the engine fires is not near so perfect as when the coal is con-

sumed by a furnace. In the former case, the air is made to pass entirely through the grate bars, and through the fire, driving off a good deal of the volatile and combustible matter of the fire unconsumed; whereas, in the furnace, the air passes over the fire with great velocity, and the combustible matter is thus again thrown upon the fire, and is almost entirely consumed; indeed, in a well worked furnace, the combustion is almost perfect. This is well known to the profession: in upcast shafts, with engine fires at the bottom, volumes of smoke are almost continually issuing; whereas, in furnace ventilation alone, there is little or no smoke emitted. This is not a simple question of comparative consumption of coal to produce the same effect, as the smoke from the engine fires adds to the weight of the column of air in the shaft, and so tends also to diminish the effect of the rarefaction.

In the consideration of the second set of inquiries, that of the effect of the steam passing up the shaft, also requires consideration. It operates, first of all, in increasing the temperature, and by the rarefaction of such heat, adds to the ventilating power. We have likewise to take into consideration the weight of the column of steam, compared with the weight of a column of air of the same temperature. And we have to take into consideration that property of steam and air, in contact with each other, to combine mechanically, and present a united bulk different from that of the simple addition of the two volumes. I have however previously stated, that it was my intention in this paper to deal with this investigation in a purely practical manner. I shall therefore simply confine myself to a statement of the theoretical result of the above questions, as deduced by the most modern inquiries, without going more into detail than is absolutely necessary to illustrate the subject.

The effect of the heat of the steam upon the column of air in the shaft will be the same as that of a similar quantity of heat communicated in any other way, except only as modified by the weight of the column of steam, in the first instance, and still further modified by the properties of air and steam when mixed. According to the specific gravity of steam, as given by Dr. Thompson, it appears that a cubic foot of steam at 60° weighs 329·4 grains, when the barometrical pressure is 30 inches, and if f be any other pressure, we have as $30 : f : : \frac{329{\cdot}4\,f}{30} = 10{\cdot}98\,f =$ the weight of a cubic foot of steam, at the force f, and temperature 60°. Let t be the temperature at the force f, and let $t' = 60°$. Then, as previously shown, $\frac{459+t}{459+t'} =$ the bulk at the temperature t, supposing the bulk at 60° to be one cubic foot. Now, the densities being inversely as the spaces which the vapor occupies, we have $\frac{459+t}{459+t'} : 1 : : 10{\cdot}98\,f : \frac{5698{\cdot}6\,f}{459+t} =$ the weight of a cubic foot of vapor in grains, at the temperature t, and force f.

It has been ascertained that gaseous fluids, which do not chemically combine, mix together without condensation when the pressure is unaltered; and that, when they are saturated, a cubic foot of air absorbs

exactly a cubic foot of steam, as it would exist in a vacuum at the same temperature. (*See* Gen. Roy's Experiments, *Quarterly Journal of Science*, vol. xiii. p. 82; or *Daniell's Meteorological Essays*, p. 174.

If the bulk of air be a, at the temperature t, and f the force of the vapor at the same temperature, and p the pressure of the atmosphere, then, since the bulk a of the air mixes with an equal bulk a of the steam at the pressure f, the bulk of the steam at the pressure p will be

$p : f : : \frac{f\,a}{p}$; and the bulk of the whole, after mixture will be

$a + \frac{f\,a}{p} = \frac{a\,(h+f)}{p}$. (*See Tredgold on Warming and Ventilating Buildings*, p. 291).

These will be useful when we shall have to estimate what practical results can be obtained in other cases from the data resulting from the present experiments.

The next consideration is the mechanical effect of the jet of steam as a propulsive force. I have already noticed the mode in which Mr. Gurney proposed to apply the jet, either at the bottom or the top of the upcast shaft; the steam from a boiler, or more than one boiler, being made to pass through small apertures, and so produce a jet of steam issuing out of each of such apertures at a very rapid velocity, and acting on the air "by impulse, or *vis a tergo*," as Mr. Gurney expresses it, "driving the whole column of air up the shaft before it."

Mr. Longridge, in a paper read before the Institute of Mining Engineers, explains the action of the jet as "that of the friction of the steam rushing through the air with great velocity, and carrying it along with it." Whether it be the one or the other, or a combination of both, or a partial vacuum created by the rapid expansion of the steam, into which the air rushes, and in which manner it is carried along with it, and also, probably, that property of steam to mix with the air, I shall not here or at this time enter further upon, but shall proceed to the investigation of the mechanical power given out or produced by such jets.

It will be necessary, as in the case of the furnace, to ascertain the amount of mechanical force exerted by jets of steam of given dimensions, and number in lbs. pressure per square foot of area of shaft, or horses' power, which we shall first of all do by ascertaining the evaporating power of a boiler, or a certain number of boilers, such as are used in the collieries where the steam jet has been applied. The form of boiler ordinarily employed is cylindrical, with hemispherical ends, generally 30 feet long by 5 feet to 5 feet 6 inches diameter; high pressure, of course. The evaporating power of such a boiler we may take at about 50 cubic feet of water per hour; and as the evaporation of one cubic foot of water per hour is generally taken to represent a horse's power, or 33,000 lbs. lifted one foot in height in a minute, we may take one of such boilers, used as a mechanical force, or as made to act as a jet of steam, as representing 50 horses' power, and so on for any greater number. We shall now inquire what number of jets such a boiler will supply with steam, say 40 lbs. per square inch.

Mr. Vivian quotes, in his evidence in 1849, "a Cornish boiler, 30½

feet long, 6 feet 2 inches diameter, as supplying a steam jet with an opening of $\frac{3}{4}$-inch square, the safety valve lifting at 50 lbs. per square inch;" thus making one jet, of an area of ·5625 square inches, pass all the steam of such a boiler at 50 lbs. per square inch.

In an experiment which I made at Hetton Colliery with two boilers, each 26 feet long and 5 feet 4 inches diameter, the evaporation was 93 cubic feet of water per hour, into steam at 40 lbs. per square inch; and this quantity of steam was barely sufficient for the supply of 37 jets $\frac{1}{4}$-inch diameter, or 1·8133 inches area. But this evaporation was more than would supply the same number of jets $\frac{3}{16}$-inch diameter, or 1·0216 inch area.

At Killingworth, I found the evaporation of three boilers, each 34 feet long and 5 feet 1 inch diameter, equal to 170 cubic feet of water, into steam at 40 lbs. per square inch per hour; and this quantity of steam was also barely sufficient to fully keep up 29 jets $\frac{3}{8}$-inch diameter each, or 3·203 inches area, the boilers being, in this case, vigorously fired.

At Tyne Main Colliery, two experiments were made, the jets being placed at the top of the pit, a short distance from the boilers, and, consequently, little or no condensation. In one experiment there were 33 jets $\frac{3}{16}$-inch diameter each, and 28 jets $\frac{3}{8}$-inch diameter each, the total area being 4·0003 inches. There were two boilers, each 30 feet long, and 6 feet diameter, with hemispherical ends; the evaporation was 115 cubic feet of water per hour, and the pressure of steam 22·5 per square inch. The boilers were very hard fired, and the steam kept up with great difficulty. The other experiment was with the same boilers, steam at 40 lbs. per square inch; 61 jets $\frac{3}{16}$-inch diameter each; area of jets, 1·684 inch; and the evaporation was 109 cubic feet of water per hour, but the steam was blowing off strong all the time, the evaporation being more than the jets could pass.

The velocity with which elastic fluids rush into a vacuum is that which a heavy body will acquire by falling through a homogeneous column equal to the height due to the pressure or elasticity of the fluid; and the velocity with which a fluid of one degree of elasticity will rush into an atmosphere of a different degree of elasticity, is that which a heavy body will acquire by falling through a homogeneous column equal to the height due to the pressure, or difference of degrees of elasticities of the two fluids. If we have, therefore, the degrees of elasticity or density of steam, we shall know at what velocity such steam will rush into the atmosphere, through a jet or aperture, out of a pipe containing a continuous supply of steam at such a density. This theorem is well known, and is—

$$v = 8 \sqrt{86{\cdot}5\,(459 + t')}$$

t' being the temperature of the steam above the pressure of the atmosphere. (*See Tredgold on the Steam Engine*, p. 89). This expression of velocity is, however, correct only when the motion is free from friction, or unretarded. Mr. Tredgold states, that the "velocity through a tube, from two to three diameters in length, should be 6·5 instead of 8." In the case of the steam jet, however, the jets are necessarily at some distance from the boilers, and the steam will be conveyed from thence by steam pipes of different diameters, and, consequently, we may assume that the

velocity will be further diminished. The velocity of steam at 40 lbs. pressure per square inch, or 288·4° temperature, will be—

$v = 6{\cdot}5\ \sqrt{86{\cdot}5\ (459 + 288{\cdot}4)} = 1652{\cdot}7$ feet per second, the velocity with which the steam would issue from the jets.

The quantity of water evaporated at Hetton was 93 cubic feet per hour; we then have,

$$\frac{93 \times 506 \times 144}{3600 \times 1{\cdot}8133} = 1038 \text{ feet per second,}$$

the velocity with which 93 cubic feet of water converted into steam of 40 lbs. pressure per square inch, 506 bulk per minute, would pass through an aperture of 1·8133 inches in area. And at Killingsworth—

$\frac{170 \times 506 \times 144}{3600 \times 3{\cdot}203} = 1074$ feet. And at Tyne Main, No. 1 experiment,—

$\frac{115 \times 959 \times 144}{3600 \times 4{\cdot}003} = 1102$ feet; and No. 2 experiment,—

$\frac{109 \times 504 \times 144}{3600 \times 1{\cdot}684} = 1311$ feet per second, the velocity of the steam out of the jets. The theoretical expression of these experiments being about 4·25 on the average (the last experiment not passing all the steam), instead of 6·5, as given by Tredgold; which is probably the more correct expression, as Tredgold gives 5· as the expression when the steam issues through a thin plate, and 5·45 through a tube of two or three diameters in length, projecting inwards.

Assuming 4·25 as the expression, we would have the velocity with steam at 40 lbs. = 1080·6 feet per second; and at 50 lbs. = 1088·4 feet per second. Having thus the number of boilers, or area of surface of evaporation, and reckoning in round numbers, 3 sq. ft. of surface of evaporation for each cubic foot of water evaporated, we shall know the mechanical power employed in any steam jet apparatus, and resolving the quantity of water into steam of the elasticity intended to be used, and adopting the theorem

$$v = 4{\cdot}25\ \sqrt{86{\cdot}5\ (459 + t')}$$

t' being the temperature of the steam equivalent to the elasticity intended to be used, we can also determine the number of jets to be used.

And if we wish to know the number of horses' power of the steam employed in the jets, or the pressure per square foot of area of shaft, we can also determine these. Thus, suppose the pressure of steam employed in the jets to be 40 lbs. per square inch = 288·4° Fah.

Then $4{\cdot}25\ \sqrt{86{\cdot}5\ (459 + 288{\cdot}4)} = 1080$ feet per second, the velocity with which the steam will issue from the jets.

Take the case of Tyne Main. 61 jets $\frac{3}{16}$-inch in diameter each = 1·6843 inch area: we have, as above, 1·6843 inches of steam, at 40 lbs. pressure, with a velocity of 1080·6 feet per second. Then $\frac{1080{\cdot}6 \times 1{\cdot}6843 \times 60}{144} =$ 758·37 cubic feet of steam per minute, and as the bulk of steam as compared with water is as 506 : 1, we have $\frac{758{\cdot}37}{506} = 1{\cdot}5$ cubic feet of water

per minute, or 90 cubic feet per hour required to be evaporated to supply jets of the area of 1.6843 inch, with steam at 40 lbs. pressure per square inch.

And if we require to know the pressure per square foot of area of shaft, we have 758·37 cubic feet of steam, to act upon an area through the cylinders, of 40·25 feet, with steam at 40 lbs. per square inch pressure, now $\frac{758{\cdot}37}{40{\cdot}25} = 18{\cdot}84$ feet per minute, the quantity of steam supplied at 40 lbs. But the velocity of air is 1231·6 feet per minute, (viz: 49·574 cubic feet of air per minute passing up the shaft, the area of which is 40·25 feet,) therefore, as 18·84 feet : 1231·6 feet : : 40 lbs. : ·6118 lbs. pressure per square inch, or $·6118 \times 144 = 88{\cdot}10$ lbs. per square foot of area of shaft.

$$\text{And } \frac{88{\cdot}11 \times 40{\cdot}25 \times 1231{\cdot}6}{33{\cdot}000} = 132 \text{ horses' power.}$$

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*Apparatus for Stopping a Railway Train.**

A very ingenious contrivance, consisting of the introduction of a series of transverse rollers under the engine and carriages of railway trains, has been invented by Mr. E. Palmer, of Woodford-green, Essex. The circumference of the rollers is placed at a short distance above the rail, and while the train proceeds in the ordinary manner they remain stationary; but in the event of the wheels leaving the path, the rollers come into instant operation, sustain the load, and, having a flanch on the inner end, act as a second series of wheels, which, supposing them to be applied to an engine, keep the propelling wheels from the ground; and, therefore, however quickly they may be revolving, their power ceases on the rollers touching the rails. The same gentleman has also invented a powerful drag carriage, formed by two strong frames, reaching from the rails to a little above the wheels in height, with projecting ends at the base—each having four slanting beams to strengthen the frame, one on each side of each wheel. The lower part of the frames has cuttings, through which the wheels work on the rails, a forked cutting from end to end to tighten on the rail when required, and are attached parallel to each other by cross-beams, well screwed in place; each frame has four iron plates reaching from the base to the top part, (one on each side of the axletrees,) and allows the carriage to move up and down. There is also a strong sliding frame, with four inclined planes attached thereto, which works inside the wheels, and above the axletrees and bearings, and upon which are the usual springs and scroll iron, supporting the carriage, which are attached to four cross-beams. This invention has the combined advantage over the brakes now in use in being more powerful and applicable at the proper place or part of the train, and in being self-acting—the sliding frame having a raised part at one end, which comes in contact with the buffers of an engine coming up against it, and projecting a sufficient distance beyond the carriage, that the inclines may be pushed forward, and the carriage lowered just previously to the rollers or wheels

* From the London Mining Journal, No. 953.

of the engine coming on the lower projecting parts of the frames for that purpose, which circumstance immediately adds half its weight to the drag carriage, which stands firm, receiving the shock on powerful buffers, transferring it to the rails by means of the forked cutting above alluded to.

For the Journal of the Franklin Institute.

Description of a new Railroad Switch Pointer. Invented by Mr. John Maston, of the Saratoga Shops. By FAIRMAN ROGERS, Civ. Eng.

The importance of a Switch Pointer which will show the engine driver at a glance, and without chance of mistake, whether the switch at any junction is in its proper position, is so great, that many forms of it have been invented, none of which have yet given perfect satisfaction, being either too clumsy, too complicated, or liable to be mistaken in their positions.

The ordinary ball attached to the upper end of the long lever, indicates the position of the switch only by the inclination of the lever from or towards the line of rails; consequently, in dark and misty weather, the lever, which is generally thin and black, cannot be seen, and the position of the ball of itself indicates nothing.

The vertical Switch Pointer, which shifts the rails by a crank at the lower end, and changes the vane at the top *across* the line of rails, or *parallel* with them, while it possesses great compactness and simplicity, has the defect, that when the switch is set for the main track, the *edge* of the vane is towards the engine driver, presenting the same appearance as if the vane were broken off altogether—an accident, by the way, which not unfrequently happens. On this switch also it is difficult to arrange lights for night signals.

The switch to be described, invented by Mr. John Maston, of the Repair Shops in Saratoga, N. Y., is intended to obviate these difficulties, and to indicate always unmistakeably for which line of rail the switch is set.

The arrangement will be easily understood by reference to the cut.

The dimensions are given for a particular case, and can be varied to suit circumstances.

The long lever of the pointer moves about a pin through its lower end, and at a distance of 1′ 1″ from this pin is jointed the horizontal bar which shifts the rails, which in this case switch through 4″.75. The entire length of the long lever from the bottom pin to the centre on which the vane is hung, is 6′ 6″.

The lever moves between the jaws of an arc 2′ 6″ from the ground, in the upper edge of which notches are made, and a spring bolt on the lever retains it in its place when set for either track—a lock can very conveniently be applied to this bolt. The vane is of cast iron, about 1′ 10″ in length, and hung upon the upper end of the lever by a pin passing through it near its centre of gravity, the round end of the vane slightly preponderating. On a lug projecting downward from the arc, a rod is

jointed at a distance of 2′ 9″.75, vertically above the lower end of the lever; the other end of this rod, which is 4′ 8″ long, being attached to a pin in the centre line of the vane, near the *point*, 11″.5 from its point of suspension. This rod is forked where it crosses the lever, as represented in the drawing, embracing a pin in the lever, to make the reversing action more steady.

When the switch is set for the main track, the rod and lever, by their relative proportions, keep the vane in a vertical position, pointing directly upwards, as shown in fig. 2, showing the *whole flat side* of the vane to the engine driver, instead of the *edge*. Then, when the bars are shifted on to a siding, the lever moves over towards the siding, and the vane is turned by the action of the rod through a quarter of a revolution, pointing towards the track for which the switch is set, as in fig. 1.

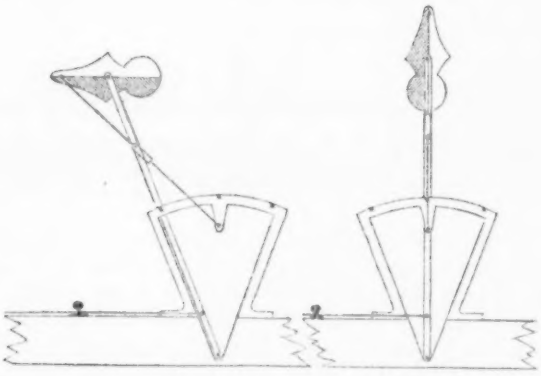

Fig. 1. Fig. 2.

Scale ¼ inch to the foot.

It is obvious, that if the switch is for three tracks, when turned to the other side, the vane will point in the right direction for the third track.

The vane is represented in the cut as painted half red, and half white, so as to be distinguished against any background.

The proportions given, can of course be modified to suit particular cases. If the sinking of the lower end of the lever below the ground should be thought objectionable, it can be raised, and the switch rod bent down to the rails, or it may be made a lever of the first order, in which case the arrangement of the shifting rod must be altered.

Its advantages appear to be principally, great distinctness, the position of the vane being so decided as not to be possibly mistaken, and being not an arbitrary signal, but one easily understood, the vane actually pointing towards the track for which the switch is set. At night, different colored lights being hung at the two extremities of the vane, their relative positions will indicate as well as the vane itself.

In case the vane and its connexions are out of order, so as not to indicate the change of track, the rod will prevent the lever from moving freely, and thus attract the attention of the switch tender.

It is not composed of any complicated pieces, requiring expensive patterns or very exact forging, and is very easily repaired. Most of the ordinary lever pointers could be altered to this plan.

This Switch Pointer has had the great advantage of the test of experience. It is not merely a model, but has been in constant use about the stations at Saratoga and Ballston, and on the main line, where I am assured by the engine drivers, who are necessarily good judges, that it gives more satisfaction than any switch hitherto used. An objection which may probably be urged against it, is, that the rods may be easily bent; but in practice this does not appear to be the case; at any rate, they being of wrought iron, can be set upon an anvil in a few minutes, if they become bent.

Having found this switch in the course of my rambles last summer, I am induced to offer this description, from the belief that it is quite an ingenious apparatus for its purposes, and not at all generally known.

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*On Hollow Railway Axles.**

The following remarks from the Lond. Mech. Mag., are a continuation of those from the Lond. Civ. Eng. Journ, published in this Journal for December 1853, p. 361.

[Com. Pub.

Mr. M'Connell exhibited a number of specimens of the axles tried in the experiments, and specimens of the hollow axles cut in two longitudinally, showing the thickness of metal to be quite uniform throughout the axle and journals. He also showed and explained an instrument used for measuring accurately the thickness of the metal at the shoulder of each journal, and in the journal after the axle was turned; it consisted of a double sliding gauge, one sliding part being inserted into the open end of the axle and shaped to fit closely to the inside of the shoulder, and the other sliding part fiting the outside of the journal and axle; the whole gauge was held steady on the body of the axle by the arm and clip. When the gauge was adjusted by a compound sliding motion so as to fit the axle inside and out, the exact position of the outer sliding portion was marked by bringing a screw stop in contact with it, and it was then withdrawn sufficiently to allow the gauge to be disengaged from the axle by drawing the inner slide out of the axle; the outer slide was then brought back to its former position by sliding it home to the screw stop, and the space thus left between the edges of the inner and outer slides gave a correct outline of the thickness of the metal, which was traced at once on paper. Each axle was examined in this manner and registered before it was sent out to work, so as to provide against any axle being turned out in an imperfect state from the journal being accidentally cut into the metal too much at the shoulder.

The Chairman (Mr. Samuel H. Blackwell) remarked, that in the fracture of the hollow axle all the iron appeared fibrous, but the fracture of the solid axles was mostly crystalline.

Mr. M'Connell said he had found the same differences in all he had

* From the London Mechanics' Magazine, October, 1853.

tried: the iron of the hollow axle was as fibrous throughout as the best bar iron.

Mr. W. Mathews inquired what was the saving in weight of the hollow axles, and whether they had yet been applied extensively?

Mr. M'Connell replied, the reduction in weight was about $\frac{2}{5}$ths theoretically to obtain the same strength, but it had been taken at $\frac{1}{3}$d of the solid axles, to be on the Midland, and Great Northern Railways, safe side. The hollow axles were being extensively applied on the North Western, and more than 500 had already been made; some had been at work for nine months with entire satisfaction.

Mr. W. Mathews asked what was the relative cost of the hollow axles, and whether any difference was found in the crystallizing of the iron from the effects of working?

Mr. M'Connell said that no observations could be made on that point yet, and it would be difficult to arrive at any conclusion upon it, except from actual long work.

Mr. Norris observed that in the fractures of the new solid axles there was considerable variation, some parts being fibrous and other parts crystalline. He said he had tried many old axles that had been twenty years at work on the Liverpool and Manchester Railway, and none of them appeared crystalline on breaking off the journals, though several new ones were found to break crystalline; the new ones were about $\frac{1}{2}$-inch larger diameter in the journals. He doubted any crystalline effect being produced by working on the railways: he thought it depended more on the original manufacture.

Mr. Slate remarked, that iron would be crystallized if over-heaten in the furnace, and the hollow axles might be injured in this way without proper care.

The Chairman said the most fibrous bar could be made crystalline in one part by overheating it.

Mr. Clift suggested, that less heat might be required to weld the hollow axle than the solid one, on account of the reduced substance of the iron, which would be less injurious to it.

Mr. M'Connell observed, that in the case of the sling chains for holding up in forging large bars, and other similar instances, the continued concussion was found to have the effect of making the iron break in a certain time quite crystalline, though it had been quite fibrous originally; this was known to take place so regularly, that the time of breaking was reckoned upon, and they sometimes lasted only a few months. In the hollow axle there was a different condition of the iron from the solid axle, as in the latter the iron in the centre was not so solid as the outside, because the pressure was only applied on the outside, and the larger the bar the more this was perceived; but in the process of manufacture of the new hollow axle, in consequence of the internal pressure combined with the external, and the small thickness of the metal, the whole axle was made as solid as the outside of an ordinary axle. It had, in fact, two skins, one outside and one inside.

Mr. Slate remarked, that the skin of iron was generally looked upon as stronger than the rest, but he doubted whether the skin was really of much importance to the strength, as it could only be thin film of scale

oxide. He should like to see the experiment tried of a hollow axle bored out and turned so as to remove the skin, and expected it would be found to make little difference.

Mr. M'Connell said the skin was important in cast iron, and the strength was considerably diminished if the skin was removed; he thought something of the same kind applied to wrought iron.

Mr. May hoped the experiment suggested would be tried; he thought the ordinary idea of the skin was a delusion, both in cast and wrought iron, and he believed there would even be found more strength per square inch in the area left if the skin were planed or turned off.

Mr. Duclos observed, that in cast iron the skin would be different in composition, assimilating to steel, and harder than the rest of the metal, if not stronger, according as it was more or less chilled, but in wrought iron the skin was mainly oxide of iron, and was really weaker than the pure iron.

Mr. Slate thought a cast iron bar planed down $\frac{1}{8}$th inch on each side would prove quite as strong per square inch as before.

Mr. James Nasmyth said he had tried a careful experiment on that very point; he cast some bars $2\frac{1}{4}$ inches square, and planed some of them down on each side 2 inches square, and he found these were 10 per cent. weaker for the proportionate transverse breaking strength. These bars were green sand castings, and consequently partially chilled; loam castings would not probably show the same effect; he considered the effect of chilling was to increase the strength.

Mr. Slate said he had made a somewhat similar trial, though not so careful an experiment, and he had not perceived any difference in the strength of the skin.

Mr. May observed, that $\frac{1}{8}$th inch on every side might be too much to remove for ascertaining the relative strength of the skin alone, as the interior of a large bar was not so strong. It has been ascertained by the experiments of the Government Commissioners, that a cast iron bar, 3 inches square, was only $\frac{7}{8}$ds the proportionate strength of a bar 1 inch square, as the centre of the bar becomes less solid in cooling; consequently, a bar 1 inch square, cut out of the centre of a 3 inch bar, would be considerably weaker than a bar cast 1 inch square, and not from the circumstance of the skin being removed, but from the iron being less solid; if only about $\frac{1}{16}$-inch were planed off a bar, it would remove the skin, but he thought the strength would be found not to be injured.

Mr. J. Nasmyth considered the skin effect extended more than $\frac{1}{8}$th inch deep, at least the chilling was perceptible so far.

Mr. G. England remarked, that if the less dense part of a solid axle at the centre were taken out by boring, the axle would not be proportionately diminished in strength; and this was in effect done in the hollow axle, with the additional advantage of the internal pressure, making the iron as sound throughout as in a thin bar, and considerably sounder and stronger than it could be in a large bar or shaft.

The Chairman said it was certainly much easier to make a bar 1 inch thick, of good quality and fibrous throughout, than one 3 or $3\frac{1}{2}$ inches thick; and in effect the hollow axle was a bar less than an inch thick throughout, in place of the ordinary solid axle, $3\frac{1}{2}$ or 4 inches thick.

Mr. M'Connell thought it had to be defined what was meant by the term skin; in forging any bar it became denser gradually at the surface, and consequently stronger, the effect penetrating to a greater or less depth, according to the circumstances, and it was that he referred to, not a mere film on the surface.

Mr. Slate remarked, that in reference to the crystallization produced in iron by concussion, he thought the effect did not take place unless the strain was beyond the elastic limit more than five or six tons per inch, so as to cause a permanent change in the arrangement of the particles of the iron. He had tried an experiment in connexion with Mr. Wild, in which a weight was suspended by a bar an inch square, and was lifted up and down eighty times per minute by an eccentric worked by a steam engine constantly, night and day. This was continued for a length of time that was supposed equivalent to the effect of twenty-five years' work, but no change or crystallization in the iron was perceived.

AMERICAN PATENTS.

List of American Patents which issued from December 13th, 1853, to January 3d, 1854, (inclusive,) with Exemplifications by CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

DECEMBER 13.

15. For an *Improved Hydrant Valve;* James Cochrane, City of New York.

Claim.—"What I claim is, 1st, Combining with the issuing pipe and main cock, or two way cocks, flat, or conical valve and leakage wasteway, a piston and chamber, or a partly flexible chamber, emptying into and receiving from the issuing pipe water, between the interval of opening and closing the main and leakage wasteway. 2d, The shutting force by hydrostatic pressure and gravity of the ordinary waste water; also, the general arrangement of the moving parts by the gravity to favor the shutting forces, substantially as described."

16. For an *Improvement in Bit Stocks of Braces;* John Comstock, New London Connecticut.

Claim.—"What I claim is, the arrangement of the ring, with its pin or screw, in combination with the eccentric-shaped back catch, and the helical spring, the whole being combined and arranged substantially as set forth."

17. For a *Mode of Fixing the Colors of Cotton Umbrellas;* Norman Cook, City of New York.

"The nature of my invention consists in applying to the cotton or gingham covering, after the completion of the umbrella, a sizing of diluted gum, india-rubber paste, or cement, which filling the pores of the cloth, enables the covering to retain its color under the circumstances which at present cause the fading of the cotton and gingham."

Claim.—"I do not claim the composition of the preparation applied; neither do I claim the application of such preparation for rendering cloth water-proof. But what I do claim is, the application of a dilute solution of india-rubber paste or cement, substantially as described, to cotton or gingham umbrella coverings, for the purpose of enveloping the fibre of the cloth, and setting the color of the same, without adding to the weight of the umbrella, as set forth.

18. For an *Improvement in Car Wheels;* Carmi Hart, Bridgeport, Connecticut.

"My wheel consists of a hub and rim in the usual form, the depth of the hub in the line of the axle being considerable, to form a sufficient space for the base of the arch between the two plates; the hub and rim are connected by two plates, which meet together about two-thirds the distance from hub to rim, and thence unite as one plate to the rim;

the front and back plate resting upon the front and back of the hub, forming an arch with its base resting upon the hub. The back plate is curved in ogee from the hub to the rim, curving out gently from its point of contact with the inner end of the hub, and curving also gently outward as it connects with the rim and its inner edges."

Claim.—"What I claim is, the arrangement of the plates of the wheel in the arch at the hub, so that its opposite sides curve in similar curves, adapting themselves to each other, and are also ogees, and whose continuation from the apex or point of union is also an ogee to the rim, in combination with the spokes or radii, which are ogees on the surface of the inner plate, and also ogees sidewise, and forms a continuous part of the inside plate itself."

19. For a *Hinge for Inkstand Covers;* Joseph Nock, Philadelphia, Pennsylvania.

"The nature of my invention consists in providing the inkstand, or ink-well cover, with a curvilinear hinge on the top of the inkstand, or ink-well cover, which cover is to be closed to form a round or smooth turned face, and gives an opportunity of cleansing when soiled, inside as well as outside, and can be used by any scholar in the public schools, or any other place, where writing ink is to be used, as it is the most convenient in opening and shutting, and of course keeps the ink clean, and saves the ink from evaporating when shut."

Claim.—"What I claim is, the application of the stamped round part, and the solid part, (or the moving lid, or cover,) fitted together as a hinge, which forms a rounded, smooth turned face, and the manner in which the pin is connected with both parts, as described, using for that purpose the aforesaid 'two pieces to form a regular curvilinear or round turned hinge,' made of any materials which will produce the intended effect."

20. For an *Improvement in Spring Clamps for Clothes Lines;* F. S. Hotchkiss and C. W. Blakeslee, Northfield, Connecticut.

"The nature of our improvement consists in joining the two pieces of wood or other material, as two levers, by inserting a piece of plate brass, or other metal, by both ends, so inserted by one end in each lever as to form a kind of hinge, by which the one end of each lever is pressed together by the spring inclining to straighten itself, and when pressure is applied to the two opposite ends, then by such pressure the mouth of the pin is opened. The two levers are hollowed out near the lower ends so as to embrace the line. These are also very convenient nippers for holding papers and other material, as sewing work, and when made with longer cusps are very handy pliers for picking up small articles."

Claim.—"What we claim is, the connecting together of the two levers as above described, by one piece of metal, in such form and manner as to constitute both spring and hinge, for the purpose set forth."

21. For an *Improvement in Turnkeys;* Melvin Jinks, Wayland, New York.

Claim.—"What I claim is, the adjustable claw, constructed and arranged substantially as described, in combination with the claw and the rolling fulcrum, having a limited motion."

22. For an *Improvement in Bedstead Fastenings;* Westley E. Merrill and Freeman Tupper, Nashua, New Hampshire.

Claim.—"What we claim is, securing the posts and rails together, by means of the corner irons attached to the ends of the rails, and the clamp or dog attached to the posts, the said corner irons and clamps, or dogs, being constructed and arranged substantially as described."

23. For an *Improvement in Harvesters and Binders;* Joseph E. Nesen, Buffalo, New York; patented in England, August 27th, 1853.

"The nature of my invention consists, 1st, in the employment or use of an endless apron, having an intermitting motion for the purpose of conveying the grain in proper quantity to the binding hooks; 2d, in gathering in bundles by means of binding hooks, the grain cut by the reaper, said grain being carried up to the hooks by the endless apron; the binding hooks are operated by means of sliders, having a reciprocating motion; 3d, in the combination of the binding hooks and endless apron.

Claim.—"I do not claim the slotted fingers, nor the teeth; neither do I claim an endless belt irrespective of the peculiar motion communicated to it; but what I claim is, 1st, giving the endless apron an intermitting motion, for the purpose of carrying the grain to the binding hooks, at intervals, and in proper quantity, said motion being communi-

cated to the apron by means of belt-shipper, worked automatically from some moving portion of the machine, substantially as described; 2d, gathering the grain in bundles or sheafs, by means of the binding hooks, or their equivalents, said binding hooks being arranged and operating in the manner as shown, motion being communicated to them by means of the reciprocating bars, substantially as described; 3d, the binding hooks, in combination with the endless, intermittently moving apron, the hooks and apron being constructed, arranged, and operating in the manner and for the purpose substantially as set forth."

24. For an *Improvement in Sectional Bedsteads;* Charles Page, North Danvers, Massachusetts.

"The nature of my invention consists in certain improvements upon a sectional bedstead, by which it is made capable of being converted at any time into an invalid bedstead, in which the position and inclination of the body and head of the patient may be adjusted independently of each other, and his feet are furnished with an elastic, yielding rest, much conducing to his ease and comfort."

Claim.—"I do not claim a sectional bedstead, the portions of which revolve upon hinges, for the purpose of more convenient transportation, or of raising the head, as may be required; neither do I claim securing the mattress permanently to the bedstead; but what I do claim is, the combination of the adjustable section with the revolving head and foot boards, constructed and operating in the manner described; by which means the bedstead may at any time be converted into an invalid bedstead, and extended in such manner that the body and head of the patient may be raised and lowered, independent of each other, his feet being furnished with an elastic foot board, in the manner set forth."

25. For an *Improvement in Peg Rasps;* Joseph Sawyer and Lyman Clark, South Royalton, Massachusetts.

Claim.—"We do not claim hanging the rasp of a tool for cleaning out pegs from the inside of shoes and boots, upon a pivot, and allowing it to adjust itself to the position required, as this has been done before, and is furthermore liable to several objections, the removal of which is the object of our present invention; but what we do claim is, the combination of the spring bolt and thumb piece, or their equivalents, with the pivoted rasp, constructed and operating in the manner and for the purpose substantially as described."

26. For *Improvements in Machines for Cutting Sheet Metal;* John Wilmington, South Bend, Indiana.

Claim.—"I do not claim the rotary shears; but what I do claim is, the vice, in combination with the tram upon which it moves, and upon which the sheet rests, during the operation of cutting, as set forth."

27. For *Improved Pump Valves;* Joel R. Bassett, Assignor to James B. Williams, Cincinnati, Ohio.

Claim.—"What I claim is, 1st, the construction, as described, of the puppet check valve, serving also as the piston of a pneumatic spring, and provided at its lower end with a small starting valve, substantially in the manner and for the objects explained; 2d, the segmental cylindric slide valve of the discharge openings, having prongs, as described, connecting it with the chuck valves upon the supply of the openings, so that the motion of the supply valves shall be communicated to the discharge valve, as explained."

28. For an *Improvement in Machines for Moulding Brick;* John Butler, Assignor to James Lully and John Butler, Buffalo, New York.

Claim.—"What I claim is, two hinged followers, so constructed and operated as to press the clay uniformly into the moulds, that is, each end alike, whether operated by gears or levers."

DECEMBER 20.

29. For an *Improvement in Grain and Grass Harvesters;* John E. Brown and Stephen S. Bartlett, Woonsocket, Rhode Island.

Claim.—"What we claim is, 1st, The double bladed or two edged knife, or its equivalent, so constructed as to cut in each direction, as it is vibrated, substantially as described. 2d, The knife, in combination with the curves and teeth. 3d, The mode of operating the double bladed knives or cutters, by means of the rack and pinions, substantially as set

forth. 4th, The arrangement of the devices which communicate the motion from the internal part of the driving wheel to the rack, substantially as set forth. 5th, The gearing, arranged and combined so as to work within the main wheel, and operate the crank upon the axle of the main wheel, substantially as described."

30. For an *Improvement in Operating Brakes by Signal Card;* William G. Creamer, New Haven County, Connecticut.

Claim.—"I do not claim the use of springs or weights to operate the brakes of a car; nor do I claim the use of a cord, or its equivalent, to act upon such springs or weights, or directly upon the brakes; neither do I claim the use of a cord for the purpose of transmitting signals; but what I do claim is, the method of attaching the lines that operate the springs or weights, to the signal line, so that the engineer may be able to close all the brakes by said line, while the same line may be used for transmitting signals from the rear of the train to the engineer, without operating the brakes."

31. For an *Improvement in Manure and other Forks;* Benjamin H. Franklin, Worcester, Massachusetts.

"The nature of my invention consists in making the tines three sided, and so arranging them in the head or stock, as that one of the flat sides shall be on top, and the other two receding from the opening between the tines, which gives the fork on top an advantage of holding the material, whilst anything which slips through between the tines does not stick fast or choke on account of the widening of the space below."

Claim.—"What I claim is, making the tines of forks three sided, substantially as described, whereby I diminish the weight, retain the strength, improve the holding properties of the fork, and, at the same time, prevent its choking, and cheapen the article."

32. For an *Improvement in Grain and Grass Harvesters;* Uriah H. Goble, Springfield, Ohio.

Claim.—"What I claim is, 1st, Making the ground or driving wheel with a conical tread, to counteract the tendency of the machine to run into the uncut grain, to prevent the side draft, and to better balance the machine by throwing the heft to the outside, or from the uncut grain, substantially as described. I also claim so hinging the platform, immediately in rear of the cutters, and giving it a rising and falling motion by means of the cam and lever, or their equivalents, when said motions are made to conform to the motions of the reel or rake, to retain, and then facilitate the discharge of the cut grain from the platform in bunches, substantially as described."

33. For an *Improvement in Shoes to Winnowers;* Joseph Montgomery and Jas. Montgomery, Lancaster, Pennsylvania.

Claim.—"What we claim is, the construction and arrangement of the ordinary shoe, so as to receive an extra shoe and door, substantially in the manner and for the purpose set forth."

34. For an *Improvement in Manure Crushers and Sowers;* Thomas F. Nelson, Clarke County, Virginia.

"The nature of my invention consists in providing an attachment consisting of certain mechanical arrangements, which may be easily affixed to any seed planter intended for sowing wheat, or other grains or seeds, in drills, by means of which attachment, in combination with an ordinary seed planter, guano and other pulverized manures may be sown in the same furrow in which the seed is deposited, and at the same time. By my invention, the guano or other manures capable of, and requiring to be triturated, may be completely pulverized by the same power by which the seed is planted and the guano deposited."

Claim.—"What I claim is, the combination of the fluted or toothed cylinders with the toothed shaft, operating as described, for the purpose of grinding and distributing guano or other pulverized manures, in the manner set forth; the whole being in combination with an ordinary seed planter."

35. For an *Improvement in Grain and Grass Harvesters;* Wm. and Thomas Schnebly, City of New York.

"What we claim is, the method of arranging the gear, in combination with the movable plate, to which the crank pin is fastened, said movable plate being located on the flanch of the second pinion, by which method we can increase or diminish the lateral distance of the motion of the cutters, substantially as described. We claim the method of construct-

ing the hollow guard fingers, each one being a single piece only, substantially as described. Also, the self-acting rake with jointed fingers, in combination with the guide rods upon which it is made to slide back and forth, substantially as described."

36. For an *Improvement in Power Rakes;* Hiram N. Tripp, Alfred, Maine.

"While the rake is in use, should the attendant desire to throw the teeth off the ground, and thereby bring the wheels down upon the same, he has only to lift the back draft bar above the shoulder pieces, and lay hold of the back draft bar, and pull backwards on it, while the horse or animal in the thills draws forward. Such conjoint action of the man and beast operates to throw the rake teeth off the ground and up into a horizontal position, which position will be preserved while the bar is in front of and resting against the front ends of the shoulder pieces. In order to restore the teeth to their vertical positions, he lifts the bar above the front ends of the shoulder pieces, and pulls back on it while the horse draws forward. Thus, by the united actions of the man in rear of the rake and the animal in the thills, the operation of turning the rake head is effected."

Claim.—"What I claim is, the combining with the rake head and shafts, a set of levers and back draft bars, substantially as set forth, so that by the conjoint action of the forward draft of the horse and the back draft of the attendant, the rake may be either turned up or off the ground and supported on its wheels, or turned down so as to bring its teeth in contact with the ground, all essentially as specified."

37. For an *Improvement in Machines for Hulling and Scouring Coffee;* Robert P. Walker, City of New York.

Claim.—"What I claim is, the combination of the springing rubber flaps, or scourers and polishers, with the angularly set hullers or beaters, the whole being constructed and arranged in any equivalent manner to that described, and operating as set forth."

38. For an *Improvement in Cotton Presses;* J. B. Armstrong, Barnwell District, S. C.

Claim.—"What I claim is, the method described, of holding the bale under compression, and preventing it from springing or yielding during the stitching and roping of the same, whilst the platen is being run down or back by means of a false top or platen, hooked or otherwise hitched to the bed, and arranged to work in connexion with the main platen, substantially as specified, whereby time is economized in the operation of the press, as set forth."

39. For an *Improvement in Attaching Hooks and Eyes to Cards;* Charles Atwood, Birmingham, (Derby,) Connecticut.

Claim.—"I do not claim the crimping and perforating of cards with mortise-like holes for the purpose of attaching hooks and eyes to, as that was secured to me in a patent dated 25th September, 1849; but I do claim the crimped and perforated cards, combined with thread or thin splints, to fasten hooks and eyes to them, substantially as described. I claim, also, the attaching of hooks by the aid of a block, clamp, and cards, or by means substantially the same, as described."

40. For an *Improvement in Candle Mould Machines;* D. E. and M. Battershall, Troy, New York.

"The nature of our invention consists in the peculiar mode or manner of cutting, centring, and holding the wick tight in the moulds in readiness for use, by means of spring jaws, with cutter, centring plate, and holder, arranged on the top or face of the machine and moulds; also, a wick tightener arranged at the bottom of the machine."

Claim.—"What we claim is, 1st, The arrangement for cutting, for centring, and for holding the wicks at one and the same operation, by means of the cutter, guide plate, jaws, springs, tumblers, crank arms, connecting rods, horizontal sliding bar, pawl, eccentric plate, and vertical sliding bar, the respective parts being arranged and operating substantially in the manner and for the purposes as described. 2d, The wick tightener, constructed and operating substantially in the manner and for the purpose as described."

41. For a *Machine for Stamping Patterns on Rollers;* James Baxendale, Providence, Rhode Island.

Claim.—"What I claim is, stamping rollers for printing cotton or other textile fabrics by means of a punch, which is attached to a weighted arm or lever, raised by a cam, and allowed to fall on an elastic gauge at regular intervals of time, while the roller is moved in the direction in which the pattern is to be repeated, substantially as set forth."

42. For an *Improvement in Hot Air Furnaces;* James Bolton, M. D., Richmond, Va.

"The nature of my invention consists in driving an air chamber (surrounding a stove, furnace, pipe, or other contrivance by heating air,) by partitions into separate compartments, each of which is to be connected with one or more separate warm air flues, so that each flue or set of flues may be supplied with warm air from that compartment exclusively with which the flue or set of flues may be connected."

Claim.—"What I claim is, the division into compartments of the air chamber surrounding a stove, furnace, pipe, or other contrivance for warming the air which it contains, so that the warm air may be drawn off by flues from each compartment, without interfering with the supply of warm air from the other compartments."

43. For an *Improvement in Metallic Trunk Frames;* Lazare Cantel, City of N. York.

Claim.—"I do not intend to confine myself to the use of this frame with leather trunks, as it may be used with other characters of trunks, and with carpet bags, hat cases, or similar articles; neither do I confine myself to the frame being square, as other shapes and sizes may be used, as suited to the articles to which the frame is applied. I am aware that the strip or plate on three sides has been used; but I am not aware of any joint or frame having been made of a bent plate or strips with ribs and grooves, as specified. And I do not claim, in general, the metallic frames, made with tongues and grooves, and hinged together at one side for the joints of trunks; but I do claim forming the joints of trunks by arming the edges of the material of which the body is composed with sheet metal covering, crimped in the form of the tongues, as specified, whereby I obtain not only a protection to the surface from wear, but also the effect of a stiffening frame, as well as strength in the tongue, and that at a small expense."

44. For an *Improvement in Shuttles;* David Carroll, Baltimore, Maryland.

Claim.—"I would state that a close shuttle has been used for sewing cloth where a cap instead of a bobbin is employed; this I do not claim; but what I do claim therein as new is, in combination with the bobbin of an ordinary shuttle, the hinged guard projecting from and over the point towards the heel of the bobbin, for the purpose of preventing the thread or yarn, when paying off too fast, from looping or tying, substantially as described."

45. For an *Improvement in Car Brakes;* John d'Homergue, City of New York.

"The nature of my invention consists in the employment of hollow sheaves attached permanently to the middle of the axles, within each of which sheaves, and detached from it, is a system of cams, moved simultaneously, and made to press against the inner periphery of the rim of the sheave, making an effectual brake."

Claim.—"What I claim is, the described arrangement of the cams upon the blocks and within the sheaves, so as to press simultaneously against the inner periphery of said sheaves by the action of the tri-branched ring, substantially as set forth."

46. For an *Improvement in Soda Water Fountains;* Alexander Frankenberg, Columbus, Ohio.

Claim.—"What I claim is, the arrangement and combination of the stop cock apparatus with reservoirs, as set forth, and for the purpose described."

47. For a *Machine for Jointing Table Tops;* W. I. Hatfield, Dayton, Ohio.

Claim.—"What I claim is, the method described, of jointing and hinging tables by means of rotary cutters, arranged and operating substantially as specified, whereby time and labor are economized, and greater accuracy is insured, as set forth."

48. For an *Improvement in Processes for Vulcanizing Caoutchouc Compounds;* L. Otto P. Meyer, Newtown, Connecticut.

"The nature of my invention consists in producing, by means of oil and other fatty substances, smooth and glossy surfaces upon the material commonly known as the hard compound of vulcanized caoutchouc or gutta percha, or other vulcanizable gums, which may be manufactured according to the processes described in letters patent of the United States, granted to Chas. Goodyear, June 15, 1844, and Nelson Goodyear, May 6, 1851.

Claim.—"What I claim is, the producing of smooth and glossy surfaces upon the hard compounds of caoutchouc and other vulcanizable gums, by means of the use of oil or other equivalent substances, applied to the surface of the prepared gum, and between the gum and the plates of metal, or the moulds, substantially as described."

49. For an *Improvement in Hand Looms;* James A. Mitchell, Ringgold, Georgia.

Claim.—"What I claim is, the combination of the keys or pegs through the rods, levers, links, and springs, or their equivalents, with the treadles, substantially in the manner described, whereby I am enabled to operate the harness of hand looms by a movement of the fingers instead of the feet. I do not, however, claim the hand loom as generally constructed or used, or as operated by feet pedals, or treadles."

50. For a *Machine for Sawing and Planing Clap Boards;* Ephraim Parker, Rock Island, Illinois.

Claim.—"What I claim is, planing or dressing the insides of two clap boards at the same time, by means of the combination of the saw, parting guide, one cutter head, and the adjustable metallic beds; the above parts being arranged and operating substantially as shown and described."

51. For an *Improvement in Carriages with Shifting Seats;* Godfrey Simon, Reading, Pennsylvania; patented in England, March 4, 1853.

Claim.—"What I claim is, the manner described, of constructing, arranging, and applying or using the movable front seat, foot-board, and dash board, and of adapting the body of the carriage thereto, as described; but I make no claim to any of the said devices severally."

52. For a *Screw for Planking Ships;* Solon Staples, Topsham, Maine.

Claim.—"I do not claim the use of screws generally, in planking vessels; but what I do claim is, the combination of the shank, its arms and screw, with the brace, screw, and chain, constructed and combined substantially in the manner and for the purposes described."

53. For an *Improvement in Guides for Sewing on Binding;* Henry L. Sweet, Foxborough, Massachusetts.

Claim.—"What I claim is, the doubling guide, as not only made with a flat mouth, or one capable of receiving the ribbon, tape, or binding, in a flattened state, but with a bent channel or sides, such as shall gradually bend or double it, and discharge it at the other end in a double state, ready to be applied to any article conveniently placed to receive it, and leave it sewed thereon, as stated."

54. For an *Improvement in Horse Shoes;* William H. Lowers, Philadelphia, Penna.

"The nature of my invention consists in making the shoes with inclined flanches or lips, raising from the front and sides of its upper surface, corresponding in form with the parts of the hoof against which they are caused to bear, when fitted to the horse or other animal, one of which flanches is so constructed as to be capable of removal for fitting the shoe, and afterwards to be replaced and fastened by a screw, wedge, or other suitable equivalent, in such a manner as to secure the shoe firmly to the hoof without the aid of the nails heretofore employed for that purpose, which tend to split and weaken the hoof, and frequently penetrate the soft and sensitive parts of the foot."

Claim.—"I do not claim the employment of flanches or lips on the upper surface of the shoe; but what I do claim is, constructing the shoe with a detached flanch secured substantially as described, so that the side and front flanches shall firmly fasten the shoe to the hoof, as set forth."

55. For a *Machine to Cut Polygonal Surfaces in Timber;* Elias Unger, Dayton, Ohio.

Claim.—"I do not claim the movable table or the revolving face plate; neither do I claim the securing of timber between standards, as such are well known; but what I do claim is, securing the timber to be dressed between two clamps on traversing carriages, by means of eccentric pins, as described, so that the faces or surfaces dressed by the cutter, may have any desired angle with the axis of the piece, for the purposes and in the manner set forth."

56. For an *Improvement in Cleansing Hair and Feathers from Insects, &c.;* Wm. Wisdom, Cleveland, Ohio.

Claim.—"I disclaim to be the originator of sal soda as a purifying agent; but what I do claim is, purifying hair and feathers by destroying noxious insects or infectious matter contained therein, by subjecting the same to a vapor bath of chlorine gas, after the material has been cleaned by a bath of sal soda, in the manner and for the purpose specified."

57. For an *Improvement in Gold Pens;* Edmund H. Bard and Henry H. Wilson, Philadelphia, Pennsylvania.

Claim.—"We do not claim the employment of flat ribs, when composed of two pieces, as such pens have been heretofore made; but what we do claim is, the construction of metallic pens having the form of the semi-cylindrical barrel combined with the angular diverging planes, by compressing the metal between correspondingly shaped dies, substantially in the manner described."

58. For an *Improvement in Separating Alcohol from Water and other Heavier Fluids;* B. F. Greenough, Cincinnati, Ohio.

Claim.—"What I claim is, the separating of alcohol and its compounds of parts of different specific gravities, by means of the pressure of a column of such liquid, thereby causing what I denominate the 'hydrostatic displacement,' as set forth."

59. For a *Shingle Machine;* Benjamin F. Stevens and Walter Kidder, Lowell, Mass.

Claim.—"What we claim is, 1st, The combination of the movable side bars with the shaving knives and cams, arranged and operated as shown and described, for the purposes set forth. 2d, The combination of the sliding arms carrying the riving knife with the driver, for the purposes and in the manner set forth."

60. For an *Improvement in Folding Bureau or Wardrobe Bedsteads;* Andres Erich Botter, City of New York.

"The nature of my invention consists in a peculiar construction of the bedstead, whereby it may be folded or shut up when desired, so as to represent a wardrobe, book case, or a like piece of furniture. The bedstead, when unfolded, is partially supported by a rectangular chest or box, which may contain a child's crib, or drawers for clothing; said chest, when the bedstead is folded or shut up, being underneath the bedstead, and forming its only support, and serving to increase the height of the bedstead, so as to conform, as regards proportion, to the kind of furniture previously named."

Claim.—"I do not claim a bedstead arranged so that it can be closed or folded, and represent or imitate, when closed or folded, a bureau, or other piece of furniture, irrespective of the peculiar arrangement of the parts described; but what I do claim is, the peculiar construction of the bedstead, as shown, viz: having the two parts connected by hinges to a chest, by which construction the bedstead may be folded or shut up during the day, occupying but little room, and resembling a piece of room furniture, and unfolded at night when desired for use; the chest being provided either with drawers, or a crib for children, as set forth."

61. For an *Improvement in Self-Acting Machines for Weighing Grain;* Isaac D. Garlick, Lyons, New York.

Claim.—"What I claim is, 1st, The auxiliary gate, when combined with the loaded bent lever and cam catch, or their equivalents, which act upon the steelyard so as to lift shortly before the weight of grain in the weighing box becomes sufficient to raise it, substantially in the manner and for the purposes set forth. I also claim suspending the weighing box in the frame, by means of the rack, pinion, and loaded lever, whereby it is made to slide up and down within said frame at each weighing, and to produce the movements, substantially as described. I also claim the arrangement and combination of the bent cam lever, the pin on the frame, and the curved elastic rod, connecting said lever with the lid for the purpose of opening the lid at each descent of the weighing box within the frame, and again closing it by the ascent thereof, substantially in the manner set forth. I also claim the suspended hopper, in combination with the vibratory lever, arranged substantially in the manner and for the purposes set forth. I also claim the combination of the notches and catch wire with the elastic shoe and pin of the lever, arranged in such a manner that said lever is successively set free from the notch, catch, and notch, respectively by the ascent, descent, and second ascent of the steelyard, substantially as set forth. I also claim the adjustable cam catch, arranged substantially as described, in combination with the shouldered rod, for the purpose set forth. I also claim the slotted rod, in combination with the vibratory lever, when arranged in such a manner that the ascent of the lever will raise the gate and hook the catch over the pin of the steelyard, but will not disturb the gate in its descent, substantially as described. I also claim the arrangement and combination of the adjustable notched and perforated disk, the coupling pins, index, arm, and stop, substantially in the manner and for the purposes set forth."

62. For an *Improvement in Steam Boilers;* Charles F. Sibbald, Philadelphia, Penna.

Claim.—"What I claim is, the fire box, deflecting plates, fire surface, and water surface, as constructed, and the whole arranged as set forth. And I also claim the additional steam chamber placed below the water surface, and behind the fire-box, and connected to the main steam chamber by a pipe passing through the smoke stack, as set forth."

63. For an *Improvement in Sewing Machines;* Sherburne C. Blodgett, Georgetown. Assignor to Charles Morey, and Morey Assignor to Nehemiah Hunt, Boston, Mass.

Claim.—"I do not limit it to the employment of all or either of such mechanical contrivances for moving either of the needles or the cloth, as I have specified, as others, well known as mechanical equivalents, may be substituted for them; neither do I confine my improvement to the precise form or forms of arrangement or arrangements of all or any of its parts, as circumstances may vary the same without changing the nature of the invention. What I claim is, the formation of sewing, in cloth or other material, by the interlooping of two threads by the conjoint action of two needles, in such manner that each needle shall be made to carry a loop of thread through a loop formed by the other needle, and through the cloth, whereby one thread serves as a binding thread to the other, substantially in the manner described."

64. For an *Improvement in Time Registers for Showing the Day of the Week and Month;* Wm. H. Akin, Assignor to Wm. J. Huntington, Ithaca, New York.

Claim.—"What I claim is, 1st, The particular arrangement of the months with their appropriate number of days, as described, on the paper, and for the purposes described; commencing Feb. 1st, Feb. 2d, Feb. 3d, and so on for 28 days only, and then all of the other months in their regular order, with their appropriate number of days for the whole year, (with the February first mentioned, and having the 28 days.) Then, again, February having 29 days, and also 8 or 10 days of another, March, at the last end of the paper, and within which 8 or 10 days the machine must be wound up every bisextile or leap year, and requiring to be wound up in the first, second, and third years after leap year, during February having the 29 days, and before the 29th day thereof. 2d, The arrangement and combined action of the rollers, showing the day of the week and drawing up the paper, exhibiting the month and days of the month in their regular order, substantially as set forth; the paper, after it is drawn between the rollers, being disposed of by winding it upon the rollers by means of a weight or spring, as described."

65. For an *Improvement in Pick Axes;* John C Conklin, Peekskill, Assignor to Dan. Tomkins, North Harverstraw, N. Y., and Daniel F. Tompkins, City of New York.

Claim.—"I do not claim the extending of the main bar through the centre of the eye of the pick axe; neither do I claim the braces which secure the handle; but what I do claim is, the combination of the said bar with the braces and the loops, substantially in the manner and for the purposes set forth."

66. For a *Machine for Folding Seidlitz Powders;* Wm. A. Martin, Brooklyn, N. Y., Assignor to W. Watson and Peter Van Zandt, City of New York.

Claim.—"What I claim is, 1st, The bars, and moved by the means shown, or any analogous device, for folding the paper in the manner specified. 2d, The frame with its cutters and blocks, in combination with the beds on which the paper lies, to divide the papers containing the powder, and fold the ends against the ends of the blocks, as described."

[The following patent was accidentally omitted in the publication of the 6th Dec., 1853.]

67. For an *Improvement in Grain Harvesters and Binders;* Peter H. Watson and Edward S. Renwick, Washington, D. C.; dated Dec. 6, 1853; ante-dated June 6, 1853.

Claim.—"What we claim is, 1st, The combination of a continuously acting rake with a binding mechanism, acting intermittently, substantially as set forth, which, among other things, gives the director of the machine an opportunity to observe the rate at which the grain for each sheaf is accumulating, so that by hastening or retarding the operation of the binding mechanism by shifting the belt on the cone pulleys, he can make the sheafs nearly of uniform size. 2d, The method of compressing the loose grain into sheafs vertically, instead of horizontally, whereby, among other advantages, the lateral dimensions of the machine are considerably diminished, which adapts it the better to running between stones and other obstructions, and enables it to cut the outside swath round a field with

less trampling and waste of the grain. 3d, The shifting conveyor, by means of which sheafs of varying length may be bound round the middle, without changing the relative positions of the cutting and tying machine, substantially as set forth. 4th, The combination, in a grain harvester, of two series of bands, one or both armed with teeth, for the purpose of carrying the grain to the binder, as set forth. 5th, The combination of a shifting stripper, with a conveyor, substantially as set forth. 6th, The combination of the discharging gate, or the equivalent thereof, with the receiving platform and the binding crib, substantially as set forth. 7th, The traveling cord nippers, or their equivalents, operating substantially as set forth. 8th, The combination of the cord with the cord feeder, substantially as set forth. 9th, The method of drawing the binding cord round the sheaf with the proper degree of tightness preparatory to tying, by means of a spring operating upon the cord spool, substantially as set forth. 10th, The traversing movement of the tying forceps in alternately opposite directions, in combination with their opening and closing movements, whereby the two ends of the band may be laid together, and may then be grasped by the forceps to be tied, thus dispensing with a finger to thread the cord through the eye of the forceps. 11th, The pronged standard, in combination with the tying forceps and the finger, or their equivalents. 12th, The method of rendering slack cord to facilitate the tying of the band by lessening the diameter of the sheaf as the cord is taken up in making the knot. 13th, The arrangement of the cord nippers upon a sliding stock, pressed down by a spring which yields to allow the stock to stand still while the compresser which carries it is moving, substantially as set forth. 14th, The retarding of the cord by means of a brake, or the equivalent thereof, applied to some point between the place at which the knot is tied, and the extremities of the cord, to ensure the stretching of its ends across the loop, preparatory to their projection through it in the operation of tying the knot, substantially as set forth. 15th, The arrangement of the sides and bottom of the binding crib, so that it can be depressed to permit the discharge of the sheaf, substantially as described. 16th, The arrangement of the cutting and binding mechanism on opposite sides of the driving wheel, substantially in the manner and for the purposes set forth."

Designs for December, 1853.

1. For *Cooking Stove;* Winslow Ames, Nashua, New Hampshire, Assignor to Hartshorn, Ames & Co., Boston, Massachusetts, December 20.

Claim.—"I claim the ornamental design of the side plate of the body of the stove, and of each of the larger and smaller doors, of either of the front or side plates."

2. For *Parlor Stove;* James Wager, Volney Richmond, and Harvey Smith, Troy, New York, December 20.

Claim.—"What we claim is, the ornamental design and configuration of parlor stove plates, such as described."

3. For a *Cylinder Coal Stove;* James Wager, Volney Richmond, and Harvey Smith, Troy, New York, December 20.

Claim.—"What we claim is, the design and configuration of the plates as described."

JANUARY 3, 1854.

1. For a *Machine for Sawing Bevel Surfaces;* Alfred C. Cook, Russellville, Ky.

"The nature of my invention consists in an adjustable swinging bevel, gauging platform or bench, which is supported by a strong stationary frame, the top of said platform serving as a carriage for feeding the stuff in an angular or straight direction, up to a saw passing up through and working in a long slit in the carriage, as it is moved back and forth, over the adjustable platform. The guide pieces or side rails of this carriage being made adjustable to allow the platform to be adjusted to suit any description of bevel desired to be cut. And the side-rest and dog against which the stuff lays or rests, being also adjustable so as to cut any desired flare, or give the stuff any angle lengthwise that may be desired. The shaft upon which this platform swings being provided with a needle or index pointer on one of its square ends, which pointer is moved to a certain number on an index plate, attached to one end of the stationary frame, as the platform is adjusted to

give a certain bevel, the said plate or index scale being set to suit the kind of work being done, and can be marked out so as to indicate any angle or bevel from a right angle to any angle desired."

Claim.—"What I claim is, the employment in the manner herein described of an adjustable swinging bevel gauging platform, provided with a sliding carriage, which has adjustable guide rails, and adjustable heel and side rest, and pointer, in combination with an index plate and cutter, the whole being constructed, arranged, and operating in the manner and for the purpose herein described."

2. For *Improvements in Feathering Paddle Wheels;* Samuel Champion and Thomas Champion, Washington, D. C.

Claim.—"We claim no particular shaped blades for our paddles, as various shapes may be used; but, as a general principle, we prefer, where it can be applied, the narrow, oar-shaped blade, reaching deep into the denser water, so as to make the engine labor in forcing it through, without much disturbing the surface. We are encouraged in this view by the narrow oar, the fins of the fish, and particularly by the long, deep propellers of the deer, that animal being among the very fastest of swimmers as well as of runners. In making these blades, we would propose as the best material, wrought iron or steel, or both, with the oblong button or guide at the shank end of the blade, forged solid, the blade next thereto being round, or nearly so, thence outwardly being flattened and widened, leaving the centre the thickest and strongest, by which means great strength will be attained. It is obvious, that various modifications may be made in the construction of this propeller without departing from the principle of our invention, and we also propose to use it either as partially or wholly submerged. What we claim is, the continuous arm or arms through the shaft, hub, or rim, with a blade on each end thereof, placed permanently at right angles to each other, so that when one is feathered in the water, the other is placed in proper position for propulsion by that act, also the reversing cam frame in combination with the oblong projections at the shank of the blades."

3. For an *Improvement in Running Gear of Wagons, &c.;* Isaac Crandal, Cherry Valley, New York.

Claim—"I am aware that Jonn Jones obtained a patent, dated January 14, 1851, which by the introduction of a helical spring and slot, or sliding bar, connecting the hounds or partial reaches (between the front and rear axles) in connexion with his perch swiveling on both axles, purposes to prevent the effect of whipping the horses with the tongue, and drawing it back to the line of travel when moved. I therefore disclaim any part of such devices as he uses. But what I do claim is, the arrangement of the spring bar, (or partial reach,) furnished with a slot, the bar connecting the sand bar and upper sway bar, in which is inserted the pin, in combination with the ordinary reach or perch and running gear of wagons, for the purpose of not only giving direction and steadiness of the tongue under all circumstances, but also preserving the set of the axle at the same time, as set forth and shown."

4. For a *Ruling Machine;* John Collmann, Silver Creek, Illinois.

"My invention refers to an improvement in machines for ruling parallel lines upon copper plates and other surfaces, and has for its object the moving laterally of the way upon which the ruling carriage runs; it consists in moving the box, to which this way is attached, along a bar passing through it, by the action of a cam working against a plate alternately sliding upon and secured to the traversing bar, the operation being peformed by means of a lever fastened to the cam, the movement of which is regulated by an adjustable stop, thus limiting the advance of the box, and regulating the distance between the lines."

Claim.—"What I claim is, the case alternately sliding upon and secured to the bar, as specified, in combination with the cam, lever, spring, and stop, arranged and operating as described, for moving the box upon the traversing bar any required distance, substantially as and for the purpose set forth."

5. For an *Improvement in Straw Cutters;* William S. Dillehay, Shelby county, Ky.

Claim.—"What I claim is, the diagonal knife with two edges, in combination with the movable scraper with its proper appendages, and the manner of its movements parallel with the edges of the knife, thereby cleansing the gauge table of all the cut straw. The double arm crank, and the other cranks, fly wheel, and pitmans, I do not claim; they have been long known to mechanics."

6. For a *Method of Forming Plates for Poly-Chromatic Printing;* John Donlevy, City of New York.

Claim.—"What I claim is, the method of producing intagliographic printing, and other plates, from forms of types, by surrounding the types whilst in contact with a glass plate or its equivalent, with plaster of paris, or some equivalent therefor, so that when set, the surface of the plaster will be on the same plane with the surface of the types, and then stereotyping the form of types thus surrounded, substantially as and for the purpose specified. I also claim the method of producing embossing plates by taking a cast, in plaster or its equivalent, from an intagliographic plate, and then stereotyping such plaster cast substantially as specified, thus producing a reverse duplicate in relief, as set forth. I also claim the method of producing what are called illuminated printing plates, for printing shaded intagliographic letters, characters, or figures, by producing an intagliographic plate, in accordance with the first part of my invention, from a form of shaded types, and then removing the plaster from the form of types, substantially as described, so that after printing in intaglio with the intagliographic plate, the shadows can be printed either with the form of types after the plaster has been removed, or with a stereotype taken therefrom, as set forth; and finally, I claim producing poly-chromatic printing plates from an intagliographic plate, by taking a cast therefrom in relief substantially as described, and from such relief obtaining what I term 'stencil plate or plates,' from which the plate or plates is or are obtained, to have the letters, characters, or figures, in whole or in part, in duplicate of the intagliographic letters, &c., and in relief substantially as described, so as to register therewith, as described."

7. For an *Improvement in Steam Boiler Furnaces;* F. P. Dimpfel, Philadelphia, Pennsylvania.

Claim.—"I do not claim lining the fire box with water tubes, nor do I claim making the tubes of water linings separately detachable; but I do claim forming the walls or sides of the furnaces of steam boilers, of a series of water tubes extending above and below the grate, and open to water spaces above and below, said spaces being so connected with each other, or with the body of the water in the boiler, as to allow free circulation, in the manner substantially and for the purposes set forth."

8. For an *Improvement in Quartz Crushing Machines;* James Hamilton, City of New York.

Claim.—"I do not claim the cylindrical pestle, or roller, in itself, as it has been used on a flat surface, and I am also aware that the cylindrical pestle has been used in a concave dish, or basin, but in this case, so far as the rolling motion is concerned, the same operates similarly to the ordinary rollers in oil mills, &c., but the sliding motion is dependent on the weight of the pestle, causing the same to slip on the inclined part and rub the ore; whereas, in my machine the ore is first cracked by the grooved upper surface of the pestle, which I am not aware has ever been before used, and the grinding is performed by a pestle set on a shaft, and having a partial rotary motion, which grinds the ore against the sides of the basin, without having any rolling motion at all; therefore, what I claim is, the means described and shown for cracking and grinding metallic ores, consisting of the cylindrical pestle, provided with grooves in its upper part to crack the lumps of ore, and set on a shaft, on which it has a partial rotary motion, and operating in connexion with the basin, in which said pestle moves to grind the ore into powder by the gradual approach of the sides of said basin to the cylindrical pestle, said pestle being also provided with a scraper or agitator in its lower surface, to operate as specified."

9. For an *Improved Method of Hanging and Operating Saw Gates;* Michael W. Helton, Bloomington, Indiana.

"The nature of my invention consists in so hanging a pair of gates, the saws of which operate in the same log, as to be self-balancing, the weight of said gates coming upon a fixed pivot or pin, and not upon the pitman, although the pitman gives them motion, and also the method of operating the gates by a pitman hinged and pivoted at its upper end, and moving in a circular plane at its lower end by a bent crank or otherwise, so as to oscillate the gates, without sustaining their weight."

Claim.—"What I claim is, the driving of the pairs of saw gates, the saws of which operate in the same log by means of a bifurcated pitman, hinged to the rocking cross beam by its two arms, and connected by a wrist upon its other end, with the crank of the driving shaft, by which means a conical gyratory motion is imparted to the pitman, for the purpose and substantially in the manner described."

10. For an *Improvement in Tuyeres;* George D. Miller, New Berlin, Pennsylvania.

Claim.—"I do not claim the chamber, passage, outlet, or valve, as such are well known; neither do I claim an additional outlet when governed by an additional cock or valve: but what I do claim is, the combination of the notched segment of cylinder, with the egress passages, and for regulating and changing the direction of the blast, substantially as set forth, when the apparatus is constructed with the additional passage."

11. For an *Improvement in Screw Bolts and Nuts;* Lucius Paige, Cavendish, Vt.

Claim.—"I do not claim the invention of a ratchet wheel and holding pawl and catch, as commonly made and applied to prevent back rotation of a wheel revolving on a shaft; but what I do claim is, the forming of a helical thread of a male screw, with notches or teeth, as specified, in combination with applying to its screw nut a dog catch or spring pawl to operate in the said teeth or notches, and prevent back rotation of the nut on the screw, substantially as set forth. I also claim the improvement of so applying the catch lever or dog, or catch to the nut, that it may project beyond one prismatic side of the nut, so that when a wrench is applied to such side of the nut and its opposite side, it may press inwards the dog, or catch, or lever thereof, or so act upon the same as to throw such dog or catch out of engagement with the teeth or notches of the male screw, so as to allow the nut to be unscrewed from the same, substantially as specified."

12. For a *Machine for Cutting Irregular Forms;* Jonathan Russell, Philadelphia, Pa.

Claim.—"What I claim is, so combining the spur wheel on the mandrel which directs the pattern, and the spur wheels for controlling the rough material with the main wheel, which moves or turns them through their respective carriages, as that the carriage which carries the pattern may have an uniform or differential advancing and receding longitudinal motion relatively, with regard to the carriage for carrying the rough material for the purpose of cutting to the same, or to a greater or less size than the pattern, substantially as described. I also claim hanging the tracers in independent frames, within the frames which carry the cutters, so as to allow the cutters to bring the rough material to the same, a greater or less size than the pattern in its transverse diameter, substantially as described. I also claim giving to the pattern and rough material, a half or less than a half revolution at each traversing motion of their respective carriages, for the purpose of cutting or reducing in longitudinal sections, without revolving the pattern or rough material, substantially as described."

13. For an *Improvement in Floor Plates and Malt Kilns;* Mathew Stewart, Philadelphia, Pennsylvania.

Claim.—"I do not claim the use of perforated sheet or plate iron in the construction of malt kiln floors; but what I claim is, 1st, The characteristic mode in which I construct the plates, with downward edges, at right angles with the surface of the plate, substantially and for the purpose as described; 2d, I claim the bearing and combining block, with the peculiar arrangement of the slots or grooves, or its equivalent, substantially and for the purpose as described; 3d, I claim the combination of the plates with the bearing and combining blocks, or its equivalent, and the peculiar manner of securing the plates and blocks down to the wrought iron bars by means of the wire holes in the vertical edges of the plates, or their equivalents, substantially and for the purpose as described."

14. For an *Improvement in Hot Air Registers;* Edward A. Tuttle, Williamsburgh, New York.

"The nature of my invention consists in the new and improved method of operating the valves of said registers and ventilators by an entirely new arrangement of the connecting rod, and its method of connexion with the fans or valves, which greatly simplifies and cheapens the construction of the register, while it is at these points more secure and equally strong."

Claim.—"I do not claim the rack and pinion movement or the crown wheel and segments; but what I do claim is, the improvement upon said William Turton's Patent Register, which consists in the improved method of maintaining the connecting rod in its proper position, substantially as described, namely, at the bottom, by a prong or prongs of the rod inserted into and working in cast raised openings on the fans or valves, and at the top by a slot or otherwise in the register front, together with the slide plate, by which arrangement the register is greatly simplified and cheapened in its cost."

15. For an *Improvement in Machines for Sticking Pins;* John B. Terry, Hartford, Connecticut.

Claim.—"What I claim is, the circular guard and circular slide, in combination with the wheel and spring, or its equivalent, whereby the pins are brought from the conductor, and dropped at the required place, as described."

16. For an *Improvement in Lowering, Raising, and Fastening Carriage Tops;* Zina S. Ogden, Assignor to Lewis C. Ogden, Glenn's Falls, New York.

Claim.—"What I claim is, the application of the lever, the shafts, eccentric circles, hooks, and the two bolts, to lower, raise and fasten carriage tops, with stationary bows, as described."

17. For an *Improved Mode of Banding Pulleys for Saws;* Dexter H. Chamberlain, Assignor to himself and Nehemiah Hunt, Boston, Massachusetts.

Claim.—"I do not claim the combination of three pulleys, (viz: a driving pulley and two others,) and an endless belt; nor do I claim the application and arrangement of such wherein the belt runs against or on the periphery of the driving pulley or wheel, and is strained between the two pulleys, and pinched between them and the driving pulley; nor do I claim an arrangement wherein one of the driven pulleys or rollers is placed between and in contact with the peripheries of the driving and other driven pulleys, while the endless belt is made to play around the two external pulleys, whereby the axles or journals of the driving and driven pulleys are relieved from friction caused by the contractile power or strain of the band, such strain being borne by the pulleys. But what I do claim is, my improved arrangement of pulleys and endless belt, whereby the driven pulley is sustained on the periphery of the driving wheel or pulley, the same consisting in placing the peripheries of the two lesser pulleys in contact with the periphery of the driving wheel, and so as to extend beyond the side thereof, and running the endless belt around the extensions of the said two pulleys, and down by the side of the driving wheel, and without any pressure or contact with its periphery, the whole being substantially as specified. And I also claim the combination of two endless belts, (arranged on opposite sides of the driving wheel,) with the bearing and belt pulleys, or their equivalents, and the driving wheel, as made to operate together, substantially as described, the same enabling me to relieve the bearings of the shafts of the several pulleys from the contractile strain of the belts. And I also claim the improvement of arranging two or more endless belts on one side of the driving wheel, and not only running all of the said belts around one shaft or drum, (or the equivalents,) supported on the periphery of the driving wheel, but respectively around other shafts, or drums, or equivalents, arranged and supported on the opposite portion of the periphery thereof, the whole being as specified."

18. For an *Improvement in Drying Book-Binder's Boards;* James H. Longbotham, Brooklyn, New York.

Claim.—"What I claim is, the use of the drying box, or chamber, endless belts for carrying the paper boards, coil of pipes arranged therein, in combination with a blower and case, having a series of coils of pipes therein for rarifying currents of air for drying book-binder's paper boards, and other substances, substantially as set forth."

19. For an *Improvement in Corn Shellers;* George A. Xander, Hamburg, Penn'a.

Claim.—"What I claim is, the improvement on the cylinder disk—that is, its oval shape, the spring being attached to the side, all as set forth. I would further state, that by riveting two half cylinders together, the cylinder may as readily be constructed double, and should I find it more practicable so to construct them, I do therefore not limit my claim merely to the single, but also the double cylinder."

20. For an *Improvement in Machines for Casting Type;* Charles Muller, City of New York.

Claim.—"What I claim is, 1st, Suspending the mould below its axis, or oscillation, substantially as described, whereby its tendency towards its centre of gravity will act in opposition to the momentum required in its movements towards and from the mould, and its movement and degree of opening are enabled to be reduced, producing the results set forth; 2d, the combination of the cam, lever, rod, lever, and rod, arranged substantially as shown, for the purpose of opening and closing the mould; 3d, filling the matrix by means of the lever, attached to the oscillating mould arm, combined as described with the lever, which receives an oscillating motion from the arm or lever, by which the oscillating motion is given to the shaft or axis upon which the mould oscillates."

21. For an *Improvement in Bedstead Fastenings;* William H. Price, Philadelphia, Pennsylvania.

Claim.—"What I claim is, the arrangement of the tenon, mortise, and wedge, in such a manner that the wedge will begin to act before the tenon is inserted in the mortise, and draw it gradually into said mortise, so as to completely close it when the fastening becomes firm, for the purpose of excluding vermin, and for other purposes set forth."

22. For an *Improvement in Machines for Polishing Leather;* Philip P. Tapley, Lynn, Massachusetts.

Claim—"I claim the described combination and arrangement of the crank wheel, the connecting rod, the swing bar, the lever, and the connecting rod, and also the improvement of making the connecting rod in two parts jointed together, and to operate as specified, whereby the contact of the dicing or polishing ball, or surface, with the leather, is prolonged under circumstances as stated."

23. For an *Improvement in Guitars;* William B. Tilton, City of New York.

Claim.—"I do not claim extending the strings from the foot to the head of the instrument; but what I do claim is, depressing the strings of guitars slightly below the bridge by passing them through perforations in the ordinary pins or pegs, or by any means substantially the same, when the strings are fastened at the foot of the instrument for causing the bridge to act as a fulcrum in producing the tension of the strings, and so relieving the sound board, as to give the instrument a richer, fuller, and a more complete tone, as set forth."

24. For an *Apparatus for Turning the Leaves of Books;* Claude Desbeaux, Paris, France.

Claim.—"I desire it to be understood that the present invention consists, 1st, in the principle of turning mechanically the leaves of music or other books, by means of a magnet and a piece of metal fixed or attached to the said leaves; 2d, in the mode described of moving this magnet, by the combination of which a good and convenient working of the system results; 3d, in the accessories which complete the said mode. I do not confine myself to the dimensions above mentioned, but I reserve to myself the construction above mentioned, of any material and of any dimensions, the placing of the pulleys vertically or horizontally. I may find it desirable to make the boxes of the "turn-pages" of wood, or of metal, according to the circumstances, to cover or not to cover them with cloth or leather, to use wood or metal, in the construction of the stands, to produce the lengthening or shortening by means of rack gearing or of levers, to change the relative proportions of the pieces, if necessary, to make the stamps or disks of polished or damaskined metal; in conclusion, to modify the details of construction on such limits which do not change the nature of my invention of the "magnetic turn-page," as set forth."

25. For an *Improvement in Power Looms;* John Shuttleworth, Frankford, Penn'a.

Claim.—"What I claim is, 1st, the connecting rod and lever, in combination with the reciprocating frame, for the purpose of giving a reciprocating motion and a rocking motion to the shaft; 2d, I claim the rocking shaft, arm, the vibrating lever, and arms, in combination with the reciprocating frame, for the purpose of giving an intermittent rotary motion to the wheel and disks; 3d, I claim the disks, constructed as described, in combination with the horizontal sliding stops, for the purpose of forcing out and drawing in said stops, in the manner described, and also for the purpose of operating the picker bar, substantially as described."

26. For an *Improved Arrangement for Cutting Screws in Lathes;* Joseph Nason, City of New York.

Claim.—"What I claim is, 1st, the mode of constructing and combining the stud, the tube, and the guide screw, by which guide screws of the various patterns used in screw cutting may be put on or taken off expeditiously; 2d, the mode of constructing the tool bearer generally, particularly as regards placing the slide rest behind the work, whereby the cutting tool is brought into such relative position with the shaft and the mandrel, that the operation of raising the tool bearer from the rail removes the tool from the work; 3d, the tool-lifter, constructed substantially as described, and employed for the purposes and in the manner specified; 4th, the combination of the guide screw, the threaded block, and the tool bearer, with the shaft, substantially as set forth, by which (1) the requisite traversing motion is imparted to the cutting tool; (2) the operations of releasing the block from the

guide screw, and removing the tool from the work, are simultaneously performed; and (3) the tool bearer may be turned back out of the way, when not in use."

27. For an *Improvement in Shanks of Hay and Manure Forks;* Reuben M. Hine, Mentz, Assignor to Horace C. Silsby, Seneca Falls, and Reuben M. Hine, Mentz, New York.

Claim.—"What I claim is, the fork, with the upper part of its prongs and its tang, constructed as here described, in combination with the ferrule, with sockets, and slot, as described."

28. For an *Improvement in Machines for Sticking Pins;* Thomas W. Harvey, City of New York, Assignor to John B. Terry, Hartford, Connecticut.

Claim.—"What I claim is, allowing one pin at a time to pass down the conductor by means of a vibrating slide or its equivalent, so as to supply one row of pins at a time by the conductors to the forceps, as specified."

29. For an *Improvement in Hemming and Cording Umbrella Covers;* Sherburn C. Blodget, Philadelphia, Pennsylvania.

Claim.—"What I claim is, the guide for cording or hemming umbrella covers, arranged upon a stand with a curved slot, to fold the hem around the cord, and a hole through which the cord is passed to its place; and this I claim, whether the guide be used alone or attached to a sewing machine."

30. For an *Improvement in Regulating the Damper of Steam Boilers by the Pressure of the Steam;* Patrick Clark, Rahway, New Jersey.

Claim.—"I do not claim operating the damper of a steam boiler fire by means of the pressure of the steam in a boiler; nor do I claim to have invented the diaphragm, nor its use to avoid friction, where fluid pressure is used to produce motion. What I do claim is, the combination of a cylindrical diaphragm, with a cylinder and piston, for the purpose of operating the damper of a boiler fire by means of the pressure of the steam."

31. For an *Improvement in Quartz Pulverizer;* Robert H. Collyer, San Francisco, California.

Claim.—"What I claim is, the arrangement of the cylinder-curved basin, vibrating arm, connecting rod, and power wheel attached to it, by which arrangement the cylinder is operated as a pulverizer and triturator, without a fixed shaft, as set forth."

32. For an *Improvement in Double-Acting Spring Hinges;* Theodore F. Engelbrecht, City of New York.

Claim.—"What I claim is, the combination of the two independent spindles, having right and left graduated slots in their sides, and against the stops of which the pins passing through the barrel of the hinge acts to operate alternately either of the springs attached to the spindles, as the door is opened outwards or inwards, with the barrel of the hinge, having flanches at opposite sides of the barrel, substantially as set forth."

33. For an *Improvement in Corn Shellers;* Banford Gilbert, Pittsburgh, Penn'a.

Claim.—"I do not claim as new the use of the feeding apron, nor the use of the toothed cylinder, or screw, separately considered; but what I do claim is, the constructing of the teeth on the cylinder and concave bed of the peculiar form described, and arranging the same in curved rows, so that during the revolution of the cylinder, the concavity of the rows of teeth on the cylinder meets the concavity of the rows of teeth on the concave bed, in combination with the screen or separator, and the self-adjusting concave bed, in the manner and for the purpose set forth."

34. For an *Improvement in Breech-Loading Fire Arms;* J. Durell Greene, Cambridge, Massachusetts.

Claim.—"I am aware that fire arms have been constructed in which the breech was forced up to its barrel by means of a screw cut upon its surface, and working in a female screw in the rear of the barrel; but as the breech required to make several turns, in order to advance it sufficiently to force it against the barrel, it was not practicable to adapt a lever to it for the purpose of operating it, which was effected by the thumb and finger, and required considerable time to accomplish it. The force that could therefore be brought to bear upon the breech was not sufficient to ensure a tight joint at its junction with the barrel, and the contrivance has failed to accomplish the desired end; I am also aware that Benjamin Chambers has obtained a patent for a movable breech secured to its

barrel by means of a divided screw upon its advance end, and working into a corresponding screw in the rear end of the barrel; I therefore claim neither of these devices, and only seek a patent for an improvemeut on the invention of the said Chambers; but what I do claim is, the combination of the movable breech with the revolving chamber, when the two are connected together by means of the divided screws, in the manner set forth, the whole being constructed and operating substantially as described."

35. For an *Improvement in Machines for Nailing Washboards;* James B. Holmes, Cincinnati, Ohio.

Claim.—"What I claim is, the use or application, substantially as set forth, of a percussion force, actuated by power to nail and clamp together the parts of a washboard, in the manner substantially as set forth."

36. For an *Improvement in Corn Planters;* Samuel Malone, Fremont, Illinois.

Claim.—"What I claim is, the peculiar construction of the horizontal slide, made reversible from end to end, for the purpose of varying the quantity of seed planted, in the manner set forth."

37. For an *Improved Ratchet Catch for Head Blocks in Saw Mills;* George F. Page, Baltimore, Maryland.

Claim.—"What I claim is, the combination of the latch, catch, and escapement pawl, in the manner and for the purposes set forth."

38. For a *Machine for Cutting Hand Rails;* Thomas Rogers, Philadelphia, Penn'a.

Claim.—"I do not claim pulleys, bands, worm wheels, or pinions, being aware that they have been used before in machinery; but I do claim the combination of the self-adjustable cutters, (reversible in motion as described,) with the jointed shaft, and devices for driving the same, in the manner and for the purpose set forth."

39. For an *Improvement in Sealing Preserve Cans;* Henry C. Nicholson and James Spratt, Cincinnati, Ohio.

Claim.—"What we claim is, the application to the aperture of a preserving vessel, of a disk, strip, or pellet of gum elastic, (or other pliant and air-tight substance,) in combination with a wire as described, or its equivalent, at the foot of the pump or tube through which the exhaust is made, whereby the said disk or pellet, being temporarily confined in its range of motion, performs the service of a valve during the exhaustion or escape of the atmospheric contents, and afterwards that of a stopper; and this we claim, whether applied or not in connexion, as described, with cement on the inner surface of the disk, for the self-sealing thereof."

40. For an *Improvement in Machinery for Sawing Logs;* Oren Stoddard, Busti, N. Y.

Claim.—"I do not intend to limit myself to the sizes or proportions of the parts, as these may be varied to suit the size of log to be operated on, and the parts of the frame, &c., may be either wood or metal, and can be so fitted as to be taken apart for transportation, and can be set up in a forest and driven by horse power, so as to prepare logs for the market directly on the spot. What I claim is, 1st, The means herein set forth for elevating the saw when it has cut through the log, by means of the ratchet pawl, lever, and parts attached, in combination with the retaining latch, operated upon by the log, when it has been forced forward the required amount to disengage said latch, and allow the saw to operate on the log, as set forth. 2d, I claim forcing the log along the required amount for each section to be sawn off by means of the roller, operated on by the lever and pawl, when said pawl is brought into action by the lever, as specified."

41. For *Improvements in Operating Cut-off Valves in Steam Engines;* Wm. Wright, Hartford, Connecticut.

Claim.—"I do not wish to limit myself to the use of the adjusting cams, in connexion with the fly-ball governor, as the position of the shaft can be regulated by hand, or by any other kind of governor; nor do I wish to be understood as limiting myself to the employment of my invention for operating puppet valves, as other valves, whether sliding or otherwise, may be operated by the same means; nor do I wish to limit myself to the special construction of the parts, so long as the same end is attained by the mere substitution of equivalents. I am aware that the cut-off valves of steam engines have been operated by cams, made in a helical form, to vary the period of closing by sliding the cam endwise; and, therefore, I do not claim, broadly, the use of the shifting cam for this

purpose; what I claim is, the employment of the rotating concentric hub, on which the toes, or their equivalents, of the lifters, rest, when the valves are closed, substantially as specified, when this is combined with a cam connected therewith, and which turns eccentrically thereon, for the purpose of opening and closing the valve, and regulating the period of closing the same, substantially as specified. And I also claim combining with the said hub and cam, a slide within them, and acting on an oblique groove within the cam, and a straight slot in the hub, substantially as specified, to determine the period of closing the valve, whilst the period of opening remains the same, as specified; and this I claim, whether the said slide be operated by a governor, or by other means.

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

Improved Apparatus for the Analysis of Coal, and for Organic Analysis generally. By J. H. Alexander and Campbell Morfit.

Early in October last, having to make an ultimate analysis of divers specimens of coal, anthracite and bituminous, we had also abundant opportunity of observing the want of certainty and uniformity of result in the methods ordinarily recommended and practised for such analysis. With all these methods, where the aim is to induce the organic or other substance under analysis to give off its carbon by combustion, in glass tubes, with oxide of copper, chromate of lead, or chlorate of potassa, either separately or mixed; and where the effects arise under a simple play of affinities at a high temperature, and are unaided by any external force or mechanical agency, variations occur to such an extent, as, in the case of anthracite coal especially, to leave the results, from several assays of the same sample, rarely identical. We have found these variations to depend, among other things, upon the grade of comminution of the matter for analysis, and its mode of intermixture with the oxidizing agents. If, for instance, the coal is too finely divided, it either protects, or is protected by the re-agents against the effect of the heat; although this may be so high as to fuse the tube and part of its contents. If, on the other hand, the coal be not finely divided enough, it protects itself. We all know the extreme difficulty of driving off the carbon from an anthracite coal, for example, even in an open crucible and over a blast; where sometimes three hours and more are spent in reducing so small a quantity as one gramme to ashes. And as for the mode of intermixture which shall be most favorable for the exposure and contact of the greatest amount of surface between the material and re-agent respectively, it is easy to see that, even after having been studied and attained in one instance, its repetition must be more the gift of good fortune than the result of any regular and unfailing manipulation.

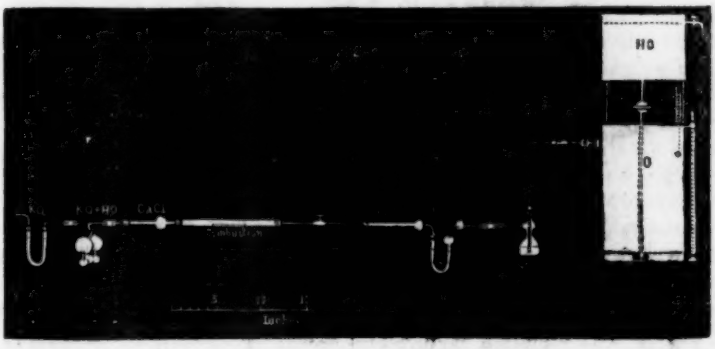
Again, in the ordinary methods, with whatever re-agent, the heat necessary to be applied, and the apparatus for its application, prevent in a great degree, if not entirely, the experimenter from observing what is going on in the tube; so that he is left without any optical grounds, or indeed any grounds at all, beyond the cessation of bubbles in the potash bulbs and an inference from the lapse of time, for judging whether the operation is properly complete or not.

Finally, in any of these methods, the ashes of the matter being lost among the fragments of the re-agents, there is rendered necessary, for the determination of this item, a partitioning of the original sample and a second special operation under all the scope for differences—slight, perhaps, but yet differences—which such partitioning always implies.

It was under these impressions, and with the view of remedying to some extent the defects which have been noticed, that we came to arrange and use the apparatus of which this note is intended to give the description. We have found in its employment that both from the comparatively low temperature necessary, and from the mechanical mode of applying and, when requisite, urging the re-agent, the rate of the whole process becomes under the strictest and most delicate control; that its progress is all the time distinctly seen, and can be judged of; and that the elements usually sought for in organic analysis, (and especially in coals, for the purpose of ascertaining their probable heating power,) are obtained from one and the same weighed portion.

Other advantages which we find it possessing—such as its convenience, being always ready after having been once arranged; its permanence, being not at all liable to get out of order with ordinary precaution; its economy, both as to the time of the experimenter and the money for combustion tubes which, in the former modes, answer but for one experiment and are then thrown away, while in this, the tube, except from some extraneous accident, never breaks and answers for the hundredth experiment as well as for the first; and, finally, the quiet and composure of the whole process, undisturbed by any explosion or decrepitation—need not be dwelt on here. They, of course, will recommend themselves to the practical analyst and are to be duly appreciated; but are not, in our opinion, to be spoken of in the same category with the main feature of accuracy and reliability of result.

The accompanying cut exhibits in section as much of the arrangement as appears necessary to its being clearly understood in connexion with the description following. The letters there are the chemical symbols to denote the occurrence and position of the several re-agents employed.



On the right hand is seen a reservoir of oxygen, somewhat modified from the ordinary Pepys' gasometer. In this, the water reservoir above is furnished with an outlet and cock, (which during use are left open, in

order to maintain a constant level,) and is fed from another vessel of water communicating with it in any convenient manner. We use a syphon. The water reservoir is supported, as usual, by three stems; only one of them, as shown, is opened and widened to hold a thermometer with a small range and open scale, whose bulb plunges into the oxygen reservoir below, and serves to indicate the temperature of the gas. The water is allowed to pass into the lower reservoir of gas by a pipe and stop-cock, as usual; and the orifice of said pipe is also made to receive adjutages of varying bore, so as to regulate with considerable exactitude the rate of supply. Connected with the gas reservoir is a glass tube, which usually indicates the level the water may have attained and consequently the quantity of oxygen on hand; but, in this instance, it is intended to answer a more precise quantitative determination. On the tube are inscribed two scales; one, deduced from the known capacity of the gasometer and calibre of the tube, to show at once the number of cubic inches occupied by the water between any two stand-points on the scale and, of course, when corrected for pressure and temperature, the corresponding volume of oxygen introduced or expelled; and the other, to show at any epoch the fraction of inches of mercury corresponding to the actual pressure of the water, counted downwards from the constant level in the upper reservoir (the design of which constancy is now apparent) to its stand in the tube; which fraction is convenient to be added at once to the observed barometric pressure, in order to give the total pressure under which the oxygen is delivered. With this total pressure and the observed temperature, the normal volume of oxygen used from epoch to epoch can be readily ascertained; the purpose of which ascertainment is, as will be seen presently, to have a check upon the numerical results otherwise obtained. This method of registering the quantity of oxygen used is not, perhaps, the best that could be devised, and leaves something to be desired on the score of minute measurement. But it was the most convenient application to the apparatus that we possessed; and as it can be read, with a vernier, to about $\frac{1}{10}$th of a cubic inch, (or $\frac{3}{100}$ths of a grain in weight nearly,) it is probably commensurate with the accuracy usually thought sufficient in checking a result furnished by other means.

With the stop-cock outlet in the upper part of the oxygen reservoir, as seen on the left of the gasometer, is connected by a pierced cork, one end of a right-angled tube that plunges its other end into a flask of strong sulphuric acid, through which the oxygen, as delivered, passes and parts with its moisture. The remainder of the moisture is supposed to be absorbed by the chloride of calcium contained in the next two tubes, as shown; the first of which, a double bulbed **U** tube, is connected by a caoutchouc wrapper with the branch proceeding from the upper tubulure of the sulphuric acid flask, and the small end of the second is bent at right angles and is corked into the open end of the first. There is no particular virtue in these various bends and tubulures; they were used because the pieces happened to be on hand, and possessed, as we judged, the quality of containing a sufficient extent of chloride of calcium in a short linear space.

If our judgment as to this sufficiency is correct, the oxygen passes

quite dry into the next small tube, furnished with a stop-cock, and connecting the last calc. chloride tube with the combustion tube itself.

This tube is needlessly long for the purposes it has to answer, which are in fact met by the stop-cock; but it happened to be on hand, and we did not desire to cut it. The purposes intended are threefold: 1st, by shutting off the cock while the gasometer is open and oxygen is being delivered, to secure a sufficient residence of the oxygen in the calc. chloride tubes for this gas to become dry—in fact, to secure a store of dry oxygen; 2d, by a similar shutting off, to convert the combustion-tube into a tube closed at one end, and thus allow of any incidental moisture being drawn off with an exhausting syringe in the usual way; and, 3d, by shutting off more or less, to regulate the flow of dry oxygen, or, if necessary, to cut off the supply altogether. When the experimenter has no assistant, the use of this stop-cock for regulation is more handy than of the one on the gasometer; for the second purpose, we have never used it ourselves, preferring to dry the combustion-tube and its contents by a sustained current of oxygen under pressure, from which there is no danger of vitiation to the result by introducing carbonic acid, as is always the case when a current of atmospheric air is employed in the same way; the first purpose is almost always advantageous, and in some cases indispensable.

We have now come to the combustion tube, which is a piece of hard German white glass, open at both ends for receiving corks. This is lined for about one-third of its length in the middle with a helix of clean and bright copper wire; the purpose of which is to reduce any of the oxides of nitrogen that might be generated from the matter in combustion, and thus to secure the transmission of this element in a free state through the remaining channels of the apparatus. It will, of course, be generally proper to clean and renew the surface of this helix by any convenient method, after each experiment. Resting on this helix is a platinum scroll of known weight, holding the matter for analysis, and retaining its ashes for being weighed after the combustion is completed. This combustion, we have always so far effected with hand-lamps of alcohol, having Argand burners; the heat given by which, is quite high enough to ensure, in a few minutes, the oxidation, in this atmosphere of oxygen, of all the carbon contained in a half grain, or even a grain of coal. To assist in the rapidity of oxidation, we found it advantageous to spread the mass of pulverized matter as thinly as possible over the surface of the platinum scroll. Instead, however, of these Argand burners, whose small extent render the scintillating and perfectly oxidizing temperature too local, we propose to employ, hereafter, a lamp with oblong hollow wicks, extending over nearly the entire length of the combustion tube, and separated by metallic diaphragms of sufficient height, to prevent the spontaneous communication of flame from one to the other, so that each wick may be lighted successively, as desired. This lighting should be commenced and the heat applied first at the end of the combustion-tube nearest the gasometer, on account of the great density of the carbonic acid produced; to assist in the discharge of which, we have found it proper to give the whole apparatus from the gasometer onward an inclination downwards of about a half inch per foot.

The gaseous products of combustion pass off first into a calc. chloride tube, whose smaller end is corked into the combustion tube, and which retains the vapor of water from the hydrogen given up by the matter; and next, into an ordinary quintuple bulb arrangement, containing a solution of potassa, which takes up the greater part of the carbonic acid that has been formed. The remaining carbonic acid (such, for instance, as may have been formed and delivered from the combustion tube faster, owing to some occasional irregularity, than could be absorbed by the potash solution, and which we have found in appreciable quantity,) is caught by, and increases the weight of the fragments of solid potassa contained in the U tube on the extreme left of the apparatus.

Finally, to complete the design which has been indicated in the calibration and graduation of the oxygen reservoir, must be imagined a bent glass tube connected with the last mentioned U tube at one end, and leading into a mercury trough under a suitable receiver, where all the remaining gases from the combustion tube are at last gathered. As these gases can be only oxygen and nitrogen, they may be transferred from the receiver into a Volta or other eudiometer; where the volume of oxygen is determined either by detonating with hydrogen, by platinum sponge, or any other eudiometric mode that may be preferred. The volume of oxygen being thus known, the volume and, consequently, the weight of the nitrogen that was in the receiver can be readily deduced.

In the mean time, the combustion being terminated, the platinum scroll, which now contains but the ashes of the matter, is withdrawn from the tube and weighed; the difference between the weight now found and the original weight of platinum alone, is that of the ashes.

We have now the weight of earthy matter and of the four principal volatile matters which constitute the coal, directly determined. And, by the use of the graduated scale on the gasometer, we have also a check upon the general accuracy of the whole operation; for, if the epochs have been carefully observed, the quantities of oxygen that by calculation must have been taken up in forming carbonic acid and water, should equal the whole quantity of oxygen directly observed to have been delivered from the gasometer during the process.

In illustration of what has been said as to the uniformity of results attainable by this method, we subjoin an extract from the note book of weights obtained successively from two portions of the same sample of coal in two different experiments; the calc. chloride tube having been changed in the interval, so as to afford a quite different initial weight, and thus having prevented any possibility of pre-occupation in making the weighings.

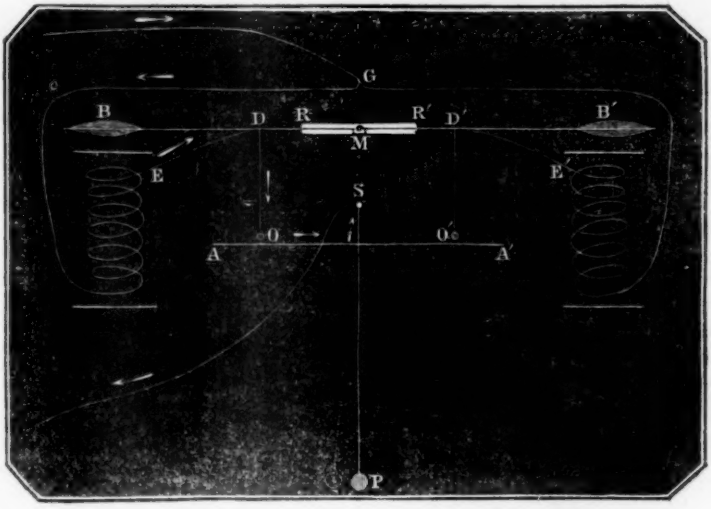
Quantity of coal taken in each experiment, 0·5 grain.

	1st Exp.	2d Exp.
HO . .	0·25 gr.	0·24 gr.
CO^2 in bulbs, .	1·59	1·61
CO^2 in U tube,	0·06	0·04
Ash, . .	0·02	0·02

Translated for the Journal of the Franklin Institute.

Veritè's Electric Clock.

We owe to the friendship of M. l'Abbé Duporq, Professor of Physics in the large Seminary of Beauvais, the description of the electric clock of M. Veritè. In making the clock, the electric communications are hidden so as to allow all possible grace. The valuable part of this delightful invention is, that it requires only a very feeble electric current; the action of M. Veritè's battery retains sufficient intensity for more than six months; its price is insignificant; a zinc or copper plate, and a little sal ammoniac or sulphate of copper are the essentials. The whole is easily included in the case of an ordinary clock, and the most delicate sense of smell could not suspect its presence. The pendulum S P, with its horizontal brass cross-piece A A′, is suspended by an elastic steel spring from a fixed point S, in communication with one of the poles of the battery. Above, a balance beam B B′, fixed on a movable axis M, is composed of an insulating part R R′, and carries at its extremities plates of soft iron, which are alternately attracted by the electro-magnets E and E′. The current comes to the electro-magnets by a wire which divides at G, and is wrapped from right to left around the electro-magnets. Finally, the current, after traversing the wire of the electro-magnet E for instance, passes to the arm B D of the beam B B′ re-descends by a very fine and flexible silver wire D O, and completes the circuit by the ball O, in its contact with the cross-piece A A′. The balls O and O′ give the impulse to this ingenious escapement of M. Veritè, applied by him in 1844.



The movement is easily understood. If a first impulse to the left is given to the pendulum, the cross-piece A A′ touches the ball O, and the current is established; the electro-magnet E pulls down the arm B D,

and with it the point of attachment D, of the wire which carries the ball. The ball O, its point of suspension being lowered, will not then abandon the cross-piece A A′, except at a point lower than that at which it met it, and consequently will give an impulse to the pendulum. But soon its contact with the cross-piece ceasing, the current ceases to pass around the electro-magnet E; then the pendulum rises on the right-hand side, the cross-piece meets the ball O′, and the same effects are reproduced on this side. The movement has commenced, and will continue so long as the current has sufficient force to cause the movement of the balance beam.

If a fork like that which works the needle of the receiver in electric telegraphs be adapted to the balance beam B B′, we have every thing necessary for marking seconds. M. Veritè gets, moreover, from the same motive power, the force necessary for his striking-works. So that we have here a clock, marking and striking the hours without weights or springs, solely by the electric force.

For the Journal of the Franklin Institute.

The San Francisco.

HULL.—Length on deck,	286 feet.
Breadth of beam,	41 "
Depth of hold,	16 "
" " to spar deck,	24 "
Length of engine and boiler space, 104 ft. by 15 ft. in width, including passages.	
Draft of water at pressure and revolutions, given below,	11 feet 6 inches.
Area of immersed midship section at this draft,	443 square feet.
Capacity of coal bunkers, in tons of coal, 500	
Draft of water at load line,	13 feet 6 inches
Floor timbers at throats, moulded,	16 "
do. do. sided,	16 "
Distance of frames apart at centres,	3 "
Masts and rig,	Foretopsail schooner.
ENGINES.—Two inclined oscillating.	
Diameter of cylinders,	65 inches.
Length of stroke,	8 feet.
Maximum revolutions per minute, 22	
BOILERS.—Two, round shell and drop fluted.	
Length of boilers,	34 "
Breadth of boilers,	13 " 6 inches.
Height of boilers, exclusive of steam chimney,	13 " 6 "
Number of furnaces, 4	
Length of grate bars,	7 "
Number of flues, 24	
Internal diameter of flues, 1st range 16 inches, 2d range 21½ inches, 3d range 17½ to 15 inches.	
Diameter of smoke pipes, (two,)	4 feet 4 inches.
Height of smoke pipes,	30 "
Maximum pressure of steam in pounds, 20	
Description of coal,	Bituminous.
Area of flue and fire surface in boilers,	6000 feet.
WATER WHEELS.—Feathering.	
Diameter,	28 "
Length of blades,	8 "
Depth of blades,	4 "
Number of blades, 14	

A description of this steamer, with the above statement of her principal dimensions, was given in this Journal about six months ago. But, since the terrible disaster which has recently befallen her, we consider the present a fitting occasion to republish that description, add to it a few particulars, and make some remarks on the causes of her loss.

The San Francisco was a steamer of about 2300 tons burthen, (custom house measurement,) built for the Pacific mail service. It is well known that the weather on the Pacific coast is less severe than that which must be encountered by vessels navigating the Atlantic. And as the exigencies of the service demand accommodation for a great number of passengers, it is usual to obtain large room on small vessels by two expedients, both of which would be objectionable for Atlantic steamers. One is to extend the guards fore and aft, narrowing from the full width at the wheel-houses, to nothing at bow and stern, giving additional deck room, but unsuited for severe weather at sea, for reasons which it is unnecessary to enlarge upon. The other is to "build on" deck-houses, with very light bulwarks, &c., which, on account of presenting large surface to the wind, and the danger to passengers of being swept overboard by heavy seas, is open to the same objection as the first expedient. With both, however, was the San Francisco provided; and they would doubtless have added much to her comfort and capacity had she reached Panama. If the propriety be questioned of sending such a vessel round Cape Horn at this season of the year, deeply laden, with a regiment of soldiers, and their stores, it should be borne in mind as an extenuating circumstance, that other vessels, apparently less able to cope with rough weather, certainly older, and in some cases possessing more objectionable features, have made the same passage in safety, and are now running on the other side.

Care seems to have been taken by the builders of the hull to render it as strong as possible, for although not heavily timbered, she was strengthened by double diagonal iron braces, secured above to a plate running the whole length of the ship under the water ways; and furthermore, her machinery being narrow, allowed of two crossed-planked, iron-braced bulkheads, fifteen feet apart, and extending the whole length of the ship from the timbers up to the spar deck, which must have added materially to her strength. Indeed, when we consider the tremendous seas she encountered, and in which she remained afloat for fifteen days, it must be conceded that the hull (guards excepted) was as strong and seaworthy as that of any steamer afloat.

Her machinery possessed some peculiar features. The boilers, two in number, were placed one forward and one abaft the engines, instead of abreast of each other, as is usual—thus admitting of the bulkheads before described. Coal was stowed alongside the boilers and engines, which occupied 104 feet length in the ship. Each boiler had a separate funnel. Her fire-rooms were air-tight, the air for combustion being supplied by fan-blowers, driven by separate engines. Two Worthington steam-pumps were fixed to the side bulkhead, under the lower deck, and were connected to a small boiler on the spar deck, so that they might be worked when the large boilers were not fired up.

Her two driving engines were oscillating, inclined 45° from the verti-

cal line, and attaching to the same crank pin. The cylinders were provided each with two piston-rods, either one the same diameter as made by the usual proportion for fixed cylinders; and for additional security, the journal block of the crank-pin (through which the two piston-rods passed like cap-bolts) was confined within guides bolted to the cylinder cover. The use of two piston-rods in oscillating engines is a novelty, and so far as could be judged from examination, without trial, seems to be an improvement. The valves were poppets with vertical stems, arranged in a simple and compact manner, steam and exhaust channels diverging from the trunions to each chest. In starting or stopping, the engineer stood on a platform moving with the cylinder. The frames of the engine were principally of boiler plate. Directly beneath the shaft, and in the angle formed by the frames, was the condenser, a large cast-iron cylinder, made to receive the tubes of a surface condenser—which, however, were removed for some cause before the departure of the ship, leaving the case to be used as a spray condenser.

The air-pump was horizontal, double-acting, driven by direct attachment to an independent steam cylinder, placed fore and aft, between the frames. Engineers are aware that one of the principal objections urged against the oscillating engine, consists in the inconvenience of working the air-pump. In double engines this has been accomplished by cranking the centre shaft, adding to its expense and weight, which arrangement is otherwise very objectionable from the fact that the centre-shaft is the part most likely to break, and its breakage might disable the condensing apparatus. An eccentric on the centre shaft is worse, on account of its enormous friction, and the same liability to give out. Where no centre shaft exists, as in single engines, the experiment has been tried of working the air-pump from an overhead beam, actuated by a link taking hold of the crank-pin journal. This was done on the Savannah steamers Augusta and Knoxville, and though superior to the former-named plans in economy and safety, is cumbrous and uncouth. Another plan which appears superior to all the others, has been tried in propeller engines, but we believe not in side-wheel engines, viz: driving by gearing. The result of the experiment on the San Francisco gives cause for regret that this latter plan had not been adopted. Those concerned in deciding on the main features of her machinery, however, no doubt took all these plans into consideration, and finally resolved upon the one we have described. The arguments which might be adduced in favor of their decision were, that besides its convenience, the pumps could be made smaller, and driven faster; that their speed could be regulated to maintain the same vacuum, even in a heavy gale of wind, when the main engines could move but slowly, although steam was following the whole stroke; that before starting, a vacuum might be obtained so that the engines could be hooked on without delay. These reasons may have decided the adoption of the scheme; the great argument against it has been developed in the event, and will be noticed hereafter.

The wheels were of the kind known as Feathering, in which the buckets enter the water in a position nearly vertical, being revolved by links attached to an eccentric ring round the shaft. The links were

placed inboard, the shafts supported on the guards, as usual in radial wheels. This feathering wheel was introduced some years ago in England, and recently the West India Mail Company put it on four of their new ships; but we understand it has since been replaced by the ordinary form. Except simplicity, we believe that no special advantage was claimed for the San Francisco's wheel over those made in England. These wheels are enormously expensive, very heavy, and from their liability to derangement, are better suited for river or bay navigation than for sea service. They might, however, have given satisfaction on the Pacific routes. Such were the main features of the San Francisco. So far as related to the proportions and mechanical execution of the work, the high reputation of its builders was fully borne out, if we are to believe those engineers who examined it before the ship left.

She was advertised to sail November 15th, but from various causes was not completed in time; indeed, her engines were not tried at the dock till the beginning of December, and after three trials down the bay, she was ready to sail on the 22d. On the first of these trials, the vacuum obtained was very poor, on the second the independent engine gave out, and the condenser tubes were removed subsequently. It appears, therefore, that the principal trouble arose from the condensing apparatus, as well on her trials as on her trip subsequently. We are under the impression that the ship never went to sea until on her regular trip. Her owners had contracted with government to convey to California eight companies of the third regiment of artillery, and in addition there were some army and navy officers, with their families, and a few civilians on board, as passengers. The stores required for this vast number of persons, and the coal for her voyage to Rio, sunk the ship considerably below her proper draft. Her cylinders were of small size, being only about $\frac{3}{8}$ the capacity of those of Collins' steamers, which are but 25 per cent. greater tonnage. Consequently, a high rate of speed could not be expected, even at her load-line, much less at the heavy draft at which she left port.

It appears from a statement published in the N. Y. Tribune, said to have originated with the Chief Engineer, that the ship had on board 3500 barrels of stores, rations, &c., which would weigh about 600 tons; and 750 tons of coal, or 250 more than her full complement. The latter is probably understated, as a voyage to Rio would require at least 35 days coal, which would give but 22 tons a day. Allowing this statement to be correct, however, and remembering that the Pacific mail steamers carry but little heavy freight, it is probable that she was overloaded to the extent of at least 600 tons, or was drawing three feet more than her ordinary load draft.

At 9 A. M., on the 22d, she left quarantine, and by her log attained a speed not exceeding $7\frac{3}{4}$ to 8 knots, during calm weather, the first thirty hours out. At this time commenced a heavy gale from N. W., shortly after which she "broached to" twice, becoming unmanageable in the trough of the sea, on the second occurrence of which she could not again be brought on her course. This was at 11 P. M.; two hours afterward, or 34 hours out of New York, and four hours after the commencement of heavy weather, the independent engine gave out by the breaking of

the air-pump piston-rod and the driving engines were stopped, there being no means of obtaining a vacuum. The vessel having previously lost her masts in the effort to bring her on her course, was by this disaster converted into an unmanageable hulk, exposed to the fury of the winds and waves; and it was only after fourteen days of intense suffering and privation, attended by great loss of life, that the vessel was finally abandoned, and the survivors taken off. It appears that an effort was made by the engineers to exhaust into the open air, by using for the purpose the smoke-stack of the small boiler, and so to continue working while endeavoring to repair the broken rod, but that, in consequence of the loss of the large smoke pipes, and the fact that the blower-belts were so low as to be covered by water, steam could not be maintained in the boilers to work the driving engines without condensing; it was also found that the small boiler had to be used for the steam pumps, and so the stack could not be used for the purpose. About three days after the break, on the 27th, the rod having, after great labor, been repaired, the engines were again started, but only to work about ten minutes, when, on the same part again giving way, the wheels of the ill-fated vessel made their last revolution.

On considering all the circumstances attending the break down, which have been gathered from the published accounts, its cause will become apparent. It is not a new expedient to work an air-pump independently of the main engine. This has before been done, *but in still water*, and not at sea; and it would seem that so long as the surface of the ocean remained tolerably smooth, no accident occurred on the San Francisco. But immediately after the vessel gets into the trough of the sea, it is not difficult to imagine that on account of the varying depth of water over the injection holes, the quantity of water entering the condenser would vary at different times; that the pump would sometimes be flooded and "brought up," and alternately accelerate its velocity until again flooded, &c. There being no adequate means of regulating speed, (for a common governor would have no effect in such a case,) this sort of action must take place in a greater or less degree; and there is reason to suppose that as the pump was double-acting, had a solid piston, and moved generally 40 to 50 strokes per minute, that however well designed or constructed may have been the machinery which gave motion to the pump, some part of it would inevitably give way under such trying strain. If this reasoning is borne out by the facts, it is an insuperable argument against a repetition of the experiment.

The only benefit which can be drawn from disasters like that of the San Francisco, is to take from them, after investigation of the causes, a warning for the future;—such is our present purpose.

From what has been said, it will be evident that the loss of the San Francisco may be traced principally to the failure of an experiment in the manner of working the air-pumps. This, in connexion with her heavy draft of water, the unsuitableness of her guards and top hamper to heavy weather, and the fact that she was sent on a long sea voyage without a proper trial trip at sea, seem to comprise all the causes of her disaster.

In the reckless disregard of human life which seems at times to charac-

terize our whole system of traveling conveyances in this country, we are all apt to overlook the deep responsibility which attaches to those who are concerned in their construction. While it happens that both in railroad and river (steamboat) navigation some hope is held out in case of disaster to passengers, who are on or near land, and generally within the reach of aid from others,—at sea, on the contrary, the violence of the weather, the danger of fire, the distance from all human aid other than that which may be furnished from within the vessel herself, combine to enhance the importance of the results which may flow from accident, and seem to call loudly on those who are concerned in the construction either of the hull or machinery for additional care, and to demand that all the resources of science and of experience shall be employed to ensure continuous and satisfactory performance of the latter. In view of such responsibility, is it right to risk the lives of passengers on any *experiment*, however plausible? Owners or builders may be confident of success, and impressed with a sense of the important advantages to be gained by some innovation on established usage; but so long as it remains an experiment, not fully tested, no one has a right to introduce it upon marine steamers—where a stoppage for a *few minutes only* may cause the destruction of the ship and lives of those on board. We recommend this train of thought to all who are in any way concerned in building up our steam marine.

For the Journal of the Franklin Institute.

Description of Trapp's Barrel Machine. By WASHINGTON JONES, Esq.

This is a machine invented by Mr. Trapp, of Elmira, New York, for making barrels, buckets, &c. It performs all the work necessary to complete a barrel, except setting up the staves, putting in the heads, and driving the hoops. The rough staves are cut from the stick of wood by a cylindrical saw of the proper diameter; the rough ends are then cut off by two circular saws, that are fixed upon the same shaft, at a distance apart somewhat more than the length the staves should be when finished; the staves are then fed to the dressing machine, which consists of a revolving circular plate, fitted with cutters that project slightly beyond its periphery, for dressing the inside or concave of the stave, and a ring that revolves upon another ring, having cutters projecting beyond its inner edge, for dressing the outside of the stave. Each dresser revolves, at a high speed, in a plane at right angles to the grain of the wood.

The staves are carried through the dressing machine by serrated rollers, and are prevented from being carried sideways by the action of the cutters, by grooved rollers, whose projections are forced into the wood by springs; the indentations are afterwards cut out with the shavings taken off by the knives of the outside dresser.

The next operation, giving the staves the proper shape and bevel on the edges, is performed thus: they are placed, one at a time, in a light frame of wood, and forced by the action of a lever upon the bed piece of the frame which has the same curve as the side of the intended barrel. The lever locks itself, and hold the stave firmly. Upon the outside of the frame, in a line perpendicular to the cross curve of the stave, and at a

distance from it equal to the half diameter of the barrel, are two projecting pins, that fit into sockets fixed to a frame that surrounds a revolving wheel, termed a jointer, fitted with cutters, which turn in a horizontal plane: the centres of the sockets are in the same plane as the cutting edges of the cutters. The pins are placed in the sockets, and the opposite side of the frame brought down until the contained stave bears upon the cutters; they remove the rough edges, and give the proper shape and bevel; the frame is turned over and the other edge of the stave finished in the same way before it is removed from the frame: this insures the same width at the ends of the staves, and consequently, the barrel made of them will be the same diameter at the heads. The "setting up" is performed by hand, and two metal hoops are driven on about one inch from each end; the barrel is then placed in two rings of metal that are arranged so as to revolve freely. One of them can be made to approach, or recede from the other, by a screw and handle; the barrel is secured by forcing the movable ring towards the other, until its motion is arrested by the metal hoops, previously driven upon the barrel, over which the two rings fit; upon the sustaining frames of the revolving rings, are three movable tools, fitted with knives of a suitable shape for smoothing the ends of the staves, giving the chamfer and cutting the croze for the reception of the head.

The barrel being made to revolve by a belt passing round it, or by some other suitable means, the tools are brought against the staves, and the superfluous wood cut away. The exact motion of each tool is regulated by a stop; this insured uniformity of length and interior diameter, which is of importance, particularly the latter, as the heads are all of one diameter, and should fit in any barrel. In making whiskey barrels, the outside is sometimes turned off, by means of a tool, that slides upon a bed of the same curve as that desired for the barrel, and fed by a screw: but, that is not absolutely required, as the staves are smooth, and of uniform thickness.

The heads are finished in this manner: after the slabs have been cut by a circular saw and the edges straightened upon the jointer, two or three of sufficient width to form the head are placed edge to edge, between two circular plates, one of which, having a number of sharp steel points projecting from the surface, revolves upon its axis; the other plate does not revolve, but, is moved in the direction of its axis, by a screw that forces the slabs against the points, which penetrate the pieces, and hold them in position: the revolving head is put in motion, and two cutters are brought by the motion of a lever against the wood, which is cut into a circular shape by their action: a further movement of the lever brings a part of the cutter in contact with the wood, giving the proper bevel to fit in the croze made in the staves to receive it. The outside of the head can be turned off, if desired, by a tool arranged for the purpose; but, as this adds to the cost of the barrel, without bettering its quality, it is not usually done. Each machine is capable of turning out from two hundred and fifty to three hundred barrels in a day, depending upon the quality and seasoning of the material. The smallest kegs, as well as the largest hogsheads, can be equally well made by the machine. One, for flour

barrels, has been built by Messrs. Reaney, Neaffie, & Co., of Philadelphia, for a company who have it in operation near the Navy Yard, where it can be seen by those interested in such matters.

For the Journal of the Franklin Institute.

Description of Birkinbine's Patent Supplementary Valve for Cornish Engines. By H. Howson, Esq.

I beg to call your attention to the accompanying sketch of a supplementary valve apparatus for cornish engines, for which a patent was granted to Mr. Birkinbine, of this city, in November last. The invention, though simple in itself, is likely to prove of considerable importance in connexion with a class of steam engines, the merits of which have as yet been scarcely appreciated in this country, but which are now beginning to attract the attention of engineers, and will, without doubt, be eventually adopted in preference to all other hydraulic machinery for mining purposes, water works, &c.

The Cornish engine, so called from its universal adoption in the mining districts of Cornwall, England, is single acting, the pressure of the steam acting on one side of the piston only, thereby raising the plunger and any requisite additional weights. The steam thus used in raising the plunger is afterwards admitted to the opposite side of the piston, and thus equalizing the pressure on both sides, the weighted plunger descends and forces the water to the required height, completing one stroke of the engine. The steam contained in the cylinder is on the commencing of another lift of the plunger carried off through the exhaust pipe to the condenser.

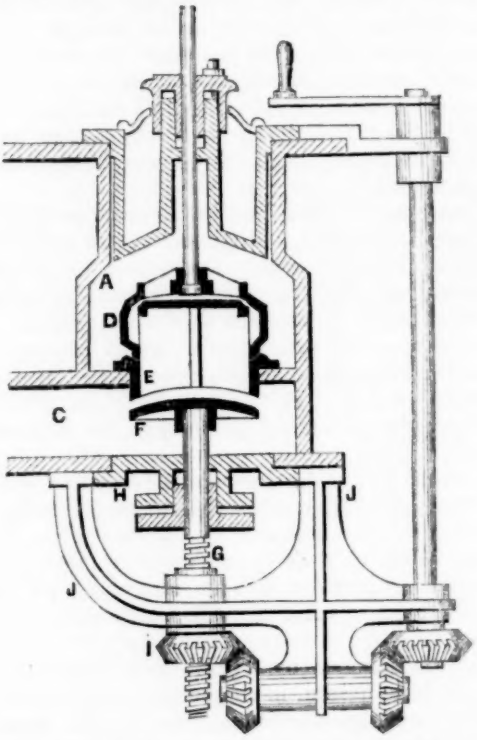
The several evolutions of the engine are effected by four valves; first, the regulator, through which is admitted the steam in the first instance, and whose movements are regulated by hand only; secondly, the steam valve which admits steam to the cylinder; thirdly, the equilibrium valve, by means of which the pressure on both sides of the piston is balanced; and, fourthly, the exhaust valve through which the steam is carried off to the condenser.

These valves are actuated by tappets on a plug rod, which moves simultaneously with the piston, in conjunction with weighted levers, and the ingenious and well known cataract motion, the tappets serving to close, and the weighted levers (whose action is dependent on the cataract) to open the several valves. These are contained each in separate compartments of a chest or nozzle, communicating with each other and with the cylinder.

The required volume of steam is, in the first instance, admitted through the regulator valve into the compartment occupied by the steam valve, on the opening of which, by a weighted lever released by the cataract, the steam is admitted to the cylinder, thereby raising the plunger to the required height. In another compartment, which communicates with the passage through which steam was admitted to the cylinder, is situated the equilibrium valve, on the raising of which, the steam in the cylinder which has performed its duty of raising the plunger, passes into the space

c, and thence through a pipe or passage to the opposite side of the piston, thus allowing the plunger to descend. The space c communicates with the chamber of the exhaust valve, as well as with the equilibrium passage; the exhaust valve is, however, closed as long as the equilibrium valve is open, and is not again brought into action until the engine is prepared to commence a new stroke.

The accompanying sketch represents a sectional view of that portion of the valve nozzle only which contains the equilibrium valve, which will no doubt be sufficient, with the foregoing brief explanation, to render Mr. Birkinbine's patent apparatus familiar to your readers.



It may be here remarked that all the valves are of the double beat description, so called from having two conical or beating surfaces instead of only one, as in the ordinary stalk valve, and are in principle similar to those used in stationary and marine engines, and denominated balance valves. D is the equilibrium valve contained in the compartment A, which communicates with the passage from the steam valve to the cylinder. The seat of the valve D is secured to the bottom of the compartment, and has a circular flanch E projecting through the opening. This projecting flanch forms the seat for the supplementary valve F, which is attached to the top of the screwed spindle G; the latter passes through a stuffing box in the cover H, and screws into the hub of the bevel wheel I, which runs

loosely in the bracket J; this wheel is caused to revolve, and thus the supplementary valve raised or lowered by the handle K, and shaft L, and the additional bevel wheels.

The object of the invention is to arrest, more or less, as circumstances require, the passage of the steam through the equilibrium valve from one side of the piston to the other, and, consequently, of regulating the descent of the plunger.

The utility of the arrangement will be at once apparent; it obviates the necessity of adopting the old and tedious process of adding and removing heavy weights, while, in case of any breakage, or other accident occurring to the pumps in a mine, the damage likely to occur from sudden shocks is prevented by the facility of adjusting the valve to regulate the descent of the plungers.

It is in Cornish engines, when used for water works, however, where the utility of this invention may be brought into practice most advantageously, especially in those works where a stand pipe is used to obtain the necessary head of water; in this case the fluctuation in the level of water is necessarily sudden, and of considerable extent, causing a similar variation of load on the engines, and rendering the machinery most unsafe and uncertain in its action.

Should the head of water in the stand pipe be low, the plunger would have a tendency to descend with a dangerous rapidity, which is checked in a moment by turning the handle K, so as to raise the supplementary valve F, thereby arresting the steam on its passage from one side of the piston to the other, the plunger consequently descending with a safe and gradual motion.

Should the head of water, on the contrary, be high, the valve F is instantly withdrawn from the seat, and a free passage given to the steam, the head of water being in itself sufficient to ensure an easy descent of the plunger.

Although the apparatus is shown in the sketch as regulated by hand, it is proposed in some instances to allow the variations in the head of the water to be the means of adjustment, an application which might be made by a simple arrangement of machinery.

It is, I am informed, Mr. Birkinbine's intention to apply his supplementary valve to the large engines he is now erecting for the West Philadelphia Water Works.

Stockton House, Philada., Jan. 10th, 1854.

For the Journal of the Franklin Institute.

The French Line-of-Battle Screw Steamship Charlemagne. By B. F. Isherwood, Chief Eng., U. S. N.

The *Charlemagne* is an old French ship of war, altered to a screw propeller steamship, in 1851, in accordance with the plans of Mr. Barnes. After this transformation, she was tried by a government Commission, which experimented with her in the Mediterranean, between Toulon and Spezzia, and from whose report, principally, the following elementary data was obtained; where it was deficient, I have completed it from other

sources. I have used the report of the Commission no farther than to select from it such observed data as was requisite for basing my own calculations and deductions.

Engines.—The engines were four in number, condensing, and direct acting, making one double stroke of piston for each revolution of the screw. The steam was cut off in the cylinders by lap on the slide valve at $\frac{7}{10}$ths of the stroke of piston from the commencement, and by cams and independent cut-off valve at $\frac{6}{10}$ths, $\frac{5}{10}$ths, $\frac{4}{10}$ths, and $\frac{3}{10}$ths the stroke of piston from the commencement.

Diameter of cylinders,	4 feet 3½ inches.
Stroke of pistons,	3 " 3⅞ "
Space displacement of all pistons per stroke,	188·014 cubic feet.

Boilers.—The boilers are four in number, with horizontal tubes returned above the furnaces. They are arranged in pairs, facing each other, with their backs against the sides of the ship, having one fire room in common, extending between the two pairs of boilers in the fore and aft direction of the vessel.

Screw.—The screw is placed in the stern of the vessel, and is fitted with the usual hoisting-out apparatus, so that it can be lifted up through a trunk in the stern, when the vessel is under sail alone. The screw makes one revolution to each double stroke of engines' pistons, and is of uniform length in the direction of the axis from hub to periphery.

Diameter of the screw,	16 feet 4·8 inches.
Pitch,	22 " 11·5 "
Number of blades,	2.
Fraction of the pitch used,	2-7.
Length of the screw in the direction of the axis,	3·28 feet.
Helicoidal area of the screw,	79·523 square feet.
Projected area of the screw on a plane at right angles to axis,	58·952 "
Diameter of the hub,	2·5 feet.

Weights of the Machinery.

Weight of engines and boilers, &c., with tools, but not with water in boilers,	217 tons.
Weight of water in boilers,	48 "
Total weight of machinery,	265 tons.

HULL.—

Length on load water line,		197·08 feet.
Breadth extreme,		53·28 "
Draft of water at the commencement of the experiments, taken below the first false keel and the stem and stern posts,	Forward,	23 ft. 0 ·7 inches.
	Mean,	24 " 2 ·7 "
	Aft,	25 " 4 ·7 "
Area of immersed amidship section at above draft,		986·31 square feet.
Displacement in tons of 2240 pounds at above draft,		4680

At the above draft of water, the vessel had on board her complete armament, (90 guns,) and the following stores, viz:

Sixty days' provisions for 864 men, estimated at	85½ tons.
Thirty days' water for 864 men, estimated at	78 "
Newcastle coal,	260 "

During the trials, the topmasts were on end and all the sails bent.

Experimental Results.—The data contained in the following table is a summary of the observations made by order of the Commission, noting every

half hour the number of revolutions made by the screw, as registered by the counter; the pressure of the steam as indicated by two gauges placed on the steam pipes; the amount of opening of the throttle valves, the point at which the steam was cut off in the cylinders, the quantity of coal consumed, the speed by log, and, finally, the state of the wind and sea.

The mean effective pressure throughout the stroke of pistons was obtained by an indicator, but the Commission, in presenting their results, subtracted from that *gross* mean effective pressure $1\frac{1}{2}$ pound per square inch of pistons for the friction of the machinery, and gave the remainder as the mean effective pressure in their report. This $1\frac{1}{2}$ pound per square inch I have restored, and have made the friction deduction in another manner, which I consider to be more exact.

Table of Results of the Trials of the Charlemagne.

Total distance run in metres,	43993	253301	122205	112302	185073	49993	
Total distance run in geograph. miles of 6082⅔ feet,	26·366	125·843	65·918	60·624	100·153	26·966	
Total time in hours and minutes of running the total distance,	3 4	14 30	8 0	8 40	10 31	3 4	
Mean speed per hour in geo. miles or knots, by the distances,	8·793	8·679	8·240	6·995	9·523	8·793	
Mean speed per hr. in knots by the log.	8·360	8·500	8·260	6·980	9·410	8·800	
Total number of revolutions of the screw for the run, by the counter,	9186	42524	22808	20490	32980	9330	
Mean number of the revolutions of the screw per minute,	49·77	46·88	47·10	36·43	52·26	50·70	
Slip of screw in per cents. of its speed, calculated for speed of vessel by the distances,	22·22	21·59	22·75	21·69	19·54	23·42	
Steam pressure in boilers in pounds per square inch above atmosphere,	7·06	3·19	2·94	3·68	5·14	5·14	
Proportion of throttle open,	·5	Wide.	Wide for 7 hours.	·3	Wide.	Wide.	
Steam cut off at from commencement of stroke of pistons,	·7	·7	·7	·5 for 1 hr. 30 min. ·7 for 7 hs. 30 min.	·7	·7	
Mean effective press. throughout stroke in pounds per sq. inch of pistons,	11·35	11·06	10·18	8·41	12·09	12·09	
Horses power developed by the engines for the above mean effective pressure throughout stroke,	926·87	850·75	786·73	502·71	1036·70	1005·76	
Resistance of the hull, or thrust of the screw, in pounds by dynamometer,	18531	17949	16483	13341	20000	20000	
Horses power expended in propelling the simple hull by dynamometer,	500·57	469·85	417·24	286·68	585·10	540·25	
Immersed amidship section of the hull in square feet,	979·96	971·33	963·90	958·54	953·19	949·97	
Number of boilers under steam,	4		4	2 for 2 hs. 40 mins.	3 for 4 hours.	4	
Pounds of coal consumed per hour,	5247		5181	3064	2659	5733	
Coal consumed per 24 hours in tons of 2240 pounds,	56·218		55·511	32 829	28·490	61·425	
State of the sea,	Calm.		Calm.	Calm.		Dead calm.	Smooth.
State of the wind,	Light br. aft.		Light aft breeze.	Calm.		Calm.	Light brz ahead.

Friction of the Screw Surface on the Water.—The foregoing data allows a calculation to be made of the power absorbed by the friction of the screw surface on the water. For this purpose the data will be taken from the 5th, or next to the last column of the above Table of Results, because as in that column will be found the most profound calm of wind and sea, no corrections will be required for a disturbed state of those elements.

The power required to overcome the friction of the engines, as ascertained by actual experiment on an engine of about the same size and speed of piston as one of the *Charlemagne's*, will be taken at 1·25 pound per square inch of pistons, and the cœfficient for the friction of the load,

according to Morin's experiments, at 0·075, which, as the mean effective pressure is 12·09 pounds per square inch, will be (12·09×0·075=) 0.91 pound per square inch, making a total of (1·25+0·91=) 2·16 per square inch for the friction resistances of the engines and load, which is 17·87 per centum of the total power developed by the engines, or 185·26 horse power. The power employed in the propulsion of the simple hull was 585·10 horses by dynamometer, and as pressure and resistance are equal and in opposite directions, the power lost in slip will bear to that utilized in the propulsion of the vessel the same ratio that the speed of the slip (or in other words, the velocity with which the water is driven back by the recession of the screw) bears to the speed of the vessel. Now, the slip of the screw was 19·54 per centum of its speed, leaving the speed of the vessel to be expressed by (100·00—19·54=) 80·46; therefore, as 80·46 : 19·54 :: 585·10 : 142·09, the horses power lost by the slip of the screw. After deducting the power 585·10 horses employed in propelling the simple hull, the power 142·09, horses lost in slip, and the power 185·26 horses expended on the friction resistances of the engines and load—total, 912·45 horses, from the total power 1036·70 horses developed by the engines, there remains (1036·70—912·45=) 124·25 horses power, which is the amount absorbed by the friction of the screw surface on the water.

Collecting the above, we have the following disposition of the power, viz:—

	Horses Power.		Per Centum.
Propelling the simple hull of the vessel, . .	585·10	or	56·44
Expended in the slip of the screw, . . .	142·09	"	13·70
Expended in the friction of the screw, . . .	124·25	"	11·99
Expended in the friction of the engines and load, .	185·26	"	17·87
Totals, ...	1036·70	or	100·00

Explanatory of the Losses of Power by Slip of the Screw.—In observing the above disposition of the power, a clear distinction must be kept in view between the power expended in the slip of the screw, 142·09 horses, or 17·87 per centum of the total power developed by the engines, which is the amount of power employed in merely giving a backward motion to the water passed by the screw, and the power actually *caused* to be lost by the slip of the screw. This latter is equal to the per centum of the screw's slip, and in the present case would amount to 19·54 per centum of the total power 1036·70 horses developed by the engines, or to 202·57 horses power: because by the reason of the screw having a slip of 19·54 per centum, and as the mean effective steam pressure on the engines' pistons continues the same, the speed of the engines has to be 19·54 per centum greater to give the vessel an equal speed in equal times than if there were no slip. Of course, this *causes* a loss of 19·54 per centum of the power required to work the engines—of the power expended in the friction of the screw surface on the water, and in the power required to propel the simple hull of the vessel. But the sum of the powers *non-utilized*, viz: those expended in slip, in friction of the screw, and engines, and load, total 451·60 horses, will remain the same, however divided; and the power 585·10 horses *utilized* in the propulsion of the vessel, will consequently remain the same also.

The foregoing disposition of the power, in connexion with the following table of calculations on the screw of the *Charlemagne*, enables us to determine the friction in the pounds avoirdupois of the square foot of the screw surface moving in its helical path with the velocity of 10 feet per second. For this purpose, the screw surface in the following table has been divided into a number of parallel strips, or *elements*, 0·25 foot wide; the length of the central helix of each of these elements has been taken as the length of the element, and the "expression for the friction of each element" has been computed separately as the friction is in the ratio of the squares of the velocities. This calculation for the expression of the friction has been made for convertibility into horse power, supposing the friction of each square foot moving with a velocity of ten feet per second to be an *unit* of weight. After the total friction of the screw for a speed of ten feet per second has been ascertained in horses power for a *unit* of weight, it is easily resolvable into the *true* friction in pounds, by dividing it into the "friction of the screw surface on the water" in horses power, as ascertained by the preceding "deposition of the power." For the rest, the table of calculations carries its own explanation.

This determination being made, gives for the value of the friction of one square foot of screw surface moving through water, in its helical path, with a velocity of ten feet per second, 0·7796 pound avoirdupois.

Calculations on the Screw of the Charlemagne.

Pitch.	Radii of elements.	Circumferences normal to radii of elements.	Pitch in used of the pitch.	Lengths of elements for one convolution of the thread.	Lengths used of the elements.	Breadths of the elements.	Helicoidal surfaces of the elements.	Speeds of the elements per second.	Speeds of the elements per minute.	Expression for the frictions of both sides of the elements.
A	B	C $2B \times 3{\cdot}1416$	D	E $\sqrt{A^2 + C^2}$	F $\frac{E}{D}$	G	H F × G	I $\frac{J}{60}$	J E × 52·26	K $\frac{I^2}{10^2} \times J \times 2$
Feet.	Feet.	Feet.	2·7	Feet.	Feet.	Feet	Sq. Ft.	Feet.	Feet.	
22·957	1·375	8·639	"	24·528	7·008	0·25	1·752	21·364	1281·83	20583·0
"	1·625	10·210	"	25·125	7·179	"	1·795	21·884	1313·03	22567·0
"	1·875	11·781	"	25·807	7·373	"	1·843	22·478	1348·67	25117·6
"	2·125	13·351	"	26·557	7·588	"	1·897	23·131	1387·87	29500·9
"	2·375	14·922	"	27·380	7·823	"	1·956	23·848	1430·88	31835·2
"	2·625	16·493	"	28·267	8·076	"	2·019	24·620	1477·23	36156·8
"	2·875	18·064	"	29·212	8·350	"	2·087	25·444	1526·62	41252·9
"	3·125	19·635	"	30·208	8·631	"	2·158	26·311	1578·67	47168·0
"	3·375	21·205	"	31·252	8·929	"	2·232	27·220	1633·23	54019·2
"	3·625	22·776	"	32·340	9·240	"	2·310	28·168	1690·09	61953·2
"	3·875	24·347	"	33·464	9·561	"	2·390	29·147	1748·83	71017·2
"	4·125	25·918	"	34·623	9·892	"	2·473	30·157	1809·40	81388·8
"	4·375	27·489	"	35·814	10·233	"	2·558	31·194	1871·64	93172·1
"	4·625	29·059	"	37·033	10·581	"	2·645	32·256	1935·34	106520·0
"	4·875	30·630	"	38·278	10·937	"	2·734	33·340	2000·41	121584·0
"	5·125	32·201	"	39·546	11·299	"	2·825	34·444	2066·67	138531·0
"	5·375	33·772	"	40·836	11·667	"	2·917	35·568	2134·09	157506·3
"	5·625	35·343	"	42·145	12·041	"	3·010	36·708	2202·50	178662·6
"	5·875	36·913	"	43·470	12·420	"	3·105	37·862	2271·74	202235·0
"	6·125	38·484	"	44·813	12·804	"	3·201	39·032	2341·93	228418·4
"	6·375	40·055	"	46·167	13·191	"	3·298	40·211	2412·69	257319·2
"	6·625	41·626	"	47·526	13·582	"	3·395	41·404	2484·23	289165·0
"	6·875	43·197	"	48·918	13·977	"	3·494	42·608	2556·45	324319·0
"	7·125	44·767	"	50·310	14·374	"	3·593	43·820	2629·20	362790·0
"	7·375	46·338	"	51·712	14·775	"	3·694	45·041	2702·47	405045·0
"	7·625	47·909	"	53·122	15·178	"	3·795	46·270	2776·16	451113·0
"	7·875	49·480	"	54·550	15·586	"	3·896	47·513	2850·78	501462·0
"	8·125	51·051	"	55·980	15·994	"	3·999	48·759	2925·52	556280·6
"	8·325	52·308	"	57·126	16·350	0·15	2·452	49·757	2985·41	382462·4
										5259145·4

$$\frac{5259145{\cdot}4}{33000} = 159{\cdot}368, \text{ and } \frac{124{\cdot}250}{159{\cdot}368} = 0{\cdot}7796$$

Relation between the Piston Pressure and the Thrust of the Screw.—It is evident that, in general, every pressure or power must be balanced by an equal and opposite resistance. The mechanical effect of a pressure is estimated by multiplying that pressure by the space through which it acts; and the mechanical effect of a resistance is estimated by multiplying that resistance by the space through which it acts. Hence, any pressure exerted on the piston of a steam cylinder, and multiplied by the space through which it acts in a given time, must exactly equal or balance the resistance multiplied by the space through which it acts in the same time. It is plain that this *general* law is entirely independent of the absolute velocities of the pressure and resistance, and that the equality will always obtain, be those absolute velocities relatively what they may.

Let us apply the above to the case of a screw actuated by a steam engine, and propelling a vessel; and let us first examine the manner in which the power of the engine is employed, premising that we know the total indicator pressure on the pistons. That total pressure is the primitive force of the steam, without loss from its transmission by the machinery. That transmission, however, cannot be effected without one loss common to all machinery, and independent of any waste in function of the machine itself, viz: the loss by *friction*. It is plain, that before the engine can move at all—that is, before it can develope power—the pressure on the piston must be more than sufficient to overcome *all* the friction resistances acting against it. In the case of propelling a vessel by the screw, which is a simple and perfect machine, operating no loss of useful effect in function of form, *all* these friction resistances will be the friction of the engine, *per se*, the friction of the load, and the friction of the screw surface on the water. It is then only what remains of the total piston pressure after deducting all these friction resistances, which is transmitted by the engine to the screw for the propulsion of the vessel; the application of this remainder of the pressure causes the screw to revolve, and thus transmit this pressure to the water in which the screw acts. The screw, therefore, transmits to the water *all* the pressure it received from the engine, and this pressure will, for one revolution of the screw, act through the length of the screw's pitch. Hence, the resistance per revolution of the screw will equal the pressure in pounds exercised by (or the result of) the screw, multiplied by the pitch of the screw, or the distance through which the resistance acts per revolution of the screw. From the foregoing it is also clear, that the power exerted to balance this resistance will be that aggregate pressure in pounds on the piston, which is left after deducting for all the friction resistances, multiplied by the space through which it acts, while the screw is making one revolution. This space will be the length of a double stroke of piston, when the engine is connected directly to the screw shaft without gearing.

From the above it is also plain, that the more or less slip of the screw does not modify or destroy the equality stated, because as the pressure of the screw is simply upon the water, it is immaterial whether the water on which the screw presses yields, and is forced back by the screw, (to which the name of slip is given,) or whether it remains unyielding, and the screw advances forward with any load whatever attached—the ves-

sel for instance—therefore, the pressure or thrust of the screw in both cases must evidently be the same, because it is solely the effect of, and must be balanced by the piston pressure. Hence also follows, that the pressure exercised by the screw upon the yielding water, must also exactly equal the pressure exercised by the screw upon the vessel in forcing it forward; consequently the power transmitted by the engine to the screw will be divided relatively between the slip of the screw and the propulsion of the vessel, in the ratio of the spaces through which the slip recedes and the vessel advances in equal time. Thus it is seen that neither the slip of the screw, nor the absolute speed of the screw, engine pistons, or vessel, can modify or destroy the equality subsisting between the thrust of the screw and the pressure on the pistons.

From all the foregoing, then, we derive *that the thrust of the screw in pounds, by dynamometer, multiplied by the space through which that thrust acts in a given time, is always equal to what remains of the total piston pressure after deduction has been made of the pressure required for overcoming all the friction, resistance of engine, load, and screw surface on the water, multiplied by the space through which said remainder of piston pressure acts in the same time.*

The experiments with the *Charlemagne*, are arranged in the Table of Results, in six columns, and were made with different velocities of engines' pistons, and of vessel. They will furnish a very good practical test, not only of the truth of the above law, but also of the accuracy of both the observed data and of the calculation based on it. The *Charlemagne* has four steam pistons, whose aggregate area amounts to 8251·6 square inches; the length of the double stroke of piston is 6·562 feet. The pitch of the screw is 22·957 feet, and the screw makes one revolution to each double stroke of piston.

The computation for the pressure required to overcome the friction resistance for the following different volumes, has been made from the data of the 5th column. The pressure required to work the engine alone is taken to be the direct ratio of the speeds of the piston. The pressure required to overcome the friction of the load is taken at Morin's coefficient of 0·075 of the total indicator pressure. The pressure required to overcome the friction of the screw is taken to be in the ratio of the squares of the velocities of the screw. The following are the detailed results, viz:

FIRST COLUMN.

Speed of the vessel, ...	8·793 knots pr. hour.
Revolutions of the screw, ...	49·77 per minute.
Mean effective pressure per square inch of pistons, .	11·35 pounds.
Friction of the engines per square inch of pistons,	1·19 pound.
" load " " "	0·85 "
" screw " " "	1·38 "
Total friction resistances per square inch of pistons, ——	3·42 pounds.
Mean effective pressure per square inch of pistons, after deducting friction resistances, . . .	7·93 "
Thrust of the screw in pounds by dynamometer, .	18531.
Expression for the power, (8251·6×7·93×6·562=) .	429385·7
Expression for the resistance, (18531×22·957=)	425416·2

SECOND COLUMN.

Speed of the vessel,	8·679 knots pr. hour.
Revolutions of the screw,	46·88 per minute.
Mean effective pressure per square inch of pistons,	11·06 pounds.
Friction of the engines per square inch of pistons, 1·12 pound.	
" load " " " 0·83 "	
" screw " " " 1·30 "	
Total friction resistances per square inch of pistons,——	3·25 pounds.
Mean effective pressure per square inch of pistons, after deducting friction resistances,	7·81 "
Thrust of the screw in pounds by dynamometer,	17949.
Expression for the power, (8251·6×7·81×6.562=)	422888.1
Expression for the resistance, (17949×22·957=)	412055.2

THIRD COLUMN.

Speed of the vessel,	8·240 knots pr. hour.
Revolutions of the screw,	47.10 per minute.
Mean effective pressure per square inch of pistons,	10.18 pounds.
Friction of the engines per square inch of pistons, 1·13 pound.	
" load " " " 0·76 "	
" screw " " " 1·31 "	
Total friction resistances per square inch of pistons,——	3·20 pounds.
Mean effective pressure per square inch of pistons, after deducting friction resistances,	6.98 "
Thrust of the screw in pounds by dynamometer,	16483.
Expression for the power, (8251·6×6·98×6·562=)	377946·1
Expression for the resistance, (16483×22·957=)	378400·2

FOURTH COLUMN.

Speed of the vessel,	6·995 knots pr. hour.
Revolutions of the screw,	36·43 per minute.
Mean effective pressure per square inch of pistons,	8·41 pounds.
Friction of the engines per square inch of pistons, 0·87 pound.	
" load " " " 0·63 "	
" screw " " " 1·01 "	
Total friction resistances per square inch of pistons,——	2·51 "
Mean effective pressure per square inch of pistons, after deducting friction resistances,	5·90 "
Thrust of the screw in pounds by dynamometer,	13341. "
Expression for the power, (8251·6×5·9×6·562=)	319467·3 "
Expression for the resistance, (13341×22·957=)	306269·3

FIFTH COLUMN.

Speed of the vessel,	9·523 knots pr. hour.
Revolutions of the screw,	52·26 per minute.
Mean effective pressure per square inch of pistons,	12·09 pounds.
Friction of the engines per square inch of pistons, 1·25 pound.	
" load " " " 0·91 "	
" screw " " " 1·45 "	
Total friction resistances per square inch of pistons,——	3·61 pounds.
Mean effective pressure per square inch of pistons, after deducting friction resistances,	8·48 "
Thrust of the screw in pounds by dynamometer,	20000.
Expression for the power, (8251·6×8·48×6·562=)	459166·6 "
Expression for the resistance, (20000×22·957=)	459140·0 "

SIXTH COLUMN.

Speed of the vessel,	8·793 knots pr. hour.
Revolutions of the screw,	50·70 per minute.
Mean effective pressure per square inch of pistons,	12·09 pounds.
Friction of the engines per square inch of pistons, 1·21 pound.	
" load " " 0·91 "	
" screw " " 1·45 "	
Total friction resistance per square inch of pistons,——	3·57 pounds.
Mean effective pressure per square inch of pistons, after deducting friction resistances,	8·52 "
Thrust of the screw in pounds by dynamometer.	20000.
Expression for the power, (8251·6×8·52×6·562=)	461332·4
Expression for the resistance, (20000×22·957=)	459140·0

The reader will not fail to observe how very closely in each case the "expression for the power" agrees with the "expression for the resistance."

It also follows from the foregoing law, that the thrust of the screw is always in the direct ratio of the effective piston pressure, and that it will always be the same with the same remainder of the piston pressure after deducting all the friction resistances, let the speed of the screw or the load upon it be what they may. It will be the same with the vessel under way, towing, or tied to the dock. This can be practically tested by taking from the six trials with the *Charlemagne* the thrusts by the screw, and dividing them by the mean effective pressure that remains after deducting the friction resistances, when the quotients will be found to be nearly equal. Had the data been exact, the quotients would have been exactly the same. The results are as follows, viz:

	Revolutions made by the screw per minute.	Mean effective pressure in pounds per square inch on the pistons after deducting all the friction resistances.	Thrust of the screw in pounds by Dynamometer.		
1st column,	49·99	7·93	18531	and	$\frac{18531}{7·93}=2336·82$
2d column,	46·88	7·81	17949	"	$\frac{17949}{7·81}=2298·21$
3d column,	49·10	6·98	16483	"	$\frac{16483}{6·98}=2361·46$
4th column,	36·43	5·90	13341	"	$\frac{13341}{5·90}=2261·18$
5th column,	52·26	8·48	20000	"	$\frac{20000}{8·48}=2358·49$
6th column,	50·90	8·52	20000	"	$\frac{20000}{8·52}=2347·42$

Evaporation by the Boiler.—An experiment was made to ascertain whether any economy in fuel would be effected by slower combustion, and using more boiler. The result is given in the 4th column of the Table of Results, and it was found that by hard firing and burning at the rate of 32·829 tons of coal per 24 hours, *two* boilers could be made to

produce sufficient steam to maintain a boiler pressure of 3·68 pounds per square inch above the atmosphere, with 36·43 revolutions of the screw per minute; while with *three* boilers, or 50 per centum more, the same amount of steam was furnished by burning at the rate of 28·490 tons of coal per 24 hours, or $13\frac{1}{5}$ per centum less than the former amount, (32·829 tons.)

The following evaporation by the boilers has been calculated from the mean of the data in the 5th and 6th columns of the Table of Results, where the throttles were carried wide. The steam pressure in the cylinders, before cutting off (at $\frac{7}{10}$ the stroke from the commencement), averaged 1·6 pound per square inch above the atmosphere. The steam space comprised in the cylinder nozzles, clearance, &c., at *one* end of the *four* cylinders, is taken at 10 cubic feet. The loss by *blowing-off* is calculated for maintaining the sea-water in the boilers at twice the natural concentration, and is included in the evaporation. The temperature of the feed water is taken at 100° Fahr. Double stroke of pistons 51·78 per minute, and Regnault's determination of the latent heat of steam is used. The following are the results, viz:

Cubic feet of steam of atmospheric pressure furnished per minute under the above conditions, ...	18070·74
Pounds of steam evaporated per hour by one pound of coal under the above conditions, ...	6·95

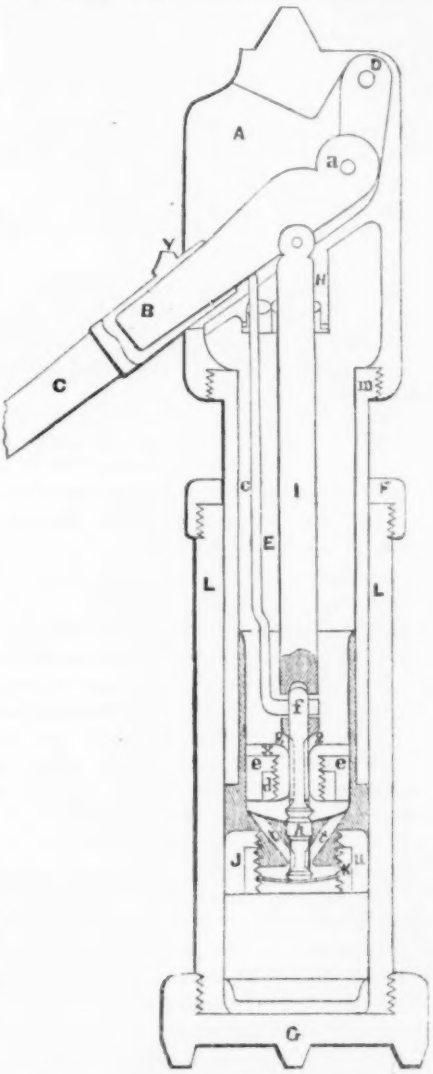
Under the ordinary conditions of practice, there would be found a considerable decrease of the above evaporation, reducing the units of steam to about 6·50 per unit of coal, instead of 6·95; because during the above experiment, the longest run being only $14\frac{1}{2}$ hours, and the run from which the data is taken only $10\frac{1}{2}$ hours, there could have been but very little, if any, cleaning of fires, and also much less *blowing-off*, than in a long run of days, as the vessel would start with full boilers of sea-water of the natural concentration.

For the Journal of the Franklin Institute.

Dudgeon's Patent Hydraulic Press.

This ingenious and useful apparatus was patented July 8th, 1852, and is becoming extensively introduced as a substitute for the old jack screw. The advantages it possesses are, 1st, Its lightness, which makes it easy for one man to shoulder a press capable of raising ten tons. 2d, The small power required to work it, every press being arranged so that one man can raise the weight for which the press is calculated. This advantage must be obvious, when we reflect that the friction of the old jack screw, which is enormous, particularly when the oil has been gummed by cold or dirt, is replaced by the very trifling friction incident to the passage of the fluid in the press through the openings. 3d, The ease with which heavy bodies may be lowered, which may be effected slowly or rapidly, as desired, by simply touching the relief valve with the working lever. 4th, The convenience of using it in confined situations, where it is difficult or impossible to turn the lever of the screw. To those who are accustomed to the use of the jack screw, and who are therefore acquainted with its inconveniences, the advantages of this press will be evident.

The inventor has proposed to apply the same arrangement to pressing cotton and goods; and indeed he exhibited in the Crystal Palace, New York, a small press of the kind, which appeared to be very convenient, and certainly cheaper than any other form of press with which we are acquainted. We annex a cut of the hydraulic jack, and a description:



The press, or "jack," shown in the cut, presents a cylindrical appearance; it consists of an outer cylinder, or case, resting on the ground, and an inner cylinder, or ram, surmounted by a boss, in which the working lever is pivoted, and which is placed under the object to be lifted, of course moving up with it. The peculiarity of the arrangement is, that the *pump* is within the hydraulic press. The liquid used is oil, of good quality, which, however, ought occasionally to be renewed; and the ram is made hollow, in order to form a reservoir large enough to contain the oil when the jack is down.

The size of the cylinder (inside) varies from two to eight or more inches, according to the weight for which the press is designed; one of $3\frac{1}{4}$ inches will readily lift 10 tons, and can be worked by one man with greater facility than two men could raise the same weight by a jack screw.

The ram, with its head, contains just so much oil or other fluid as is requisite to fill the cylinder when the ram is all the way up; and when it is lowered, the fluid returns again to the original cavity upon the small valve, *h*, being forced open by the lever. This lever is detached, and may be put in at pleasure; it is shown in the cut upside down, and the press is in the act of lowering, so that the lever, by being pressed down, has forced open the small valve, *h*, by the rod, *e*, acting on the piston, *f*. When the

lever is raised, a small spring under the valve, *h*, shuts it, and arrests the descent of the ram. When the ram is to be raised, the lever is taken off, and put in right side up, or with the projection, *y*, downwards; which brings up on the bottom of the slot in which the lever works, and limits its down stroke before it touches the rod, *e*. The force pump barrel, J, is fitted into the lower end of the ram, and its piston, consisting of top and bottom pieces, *x* and *d*, with leather between, is connected by the rod, I, to the lever, B. The valves, *f* and *h*, have gutters or channels cut in their sides, along which the fluid can pass when the valves are down or open; the piston rod, I, is kept in line by passing through the stuffing box, H; and the short link, D, to which the lever is attached, makes a species of parallel motion. The piston and ram and the cylinder bottom are kept tight by cup leathers, as used in hydraulic presses. The action of the pump will be readily seen by reference to the cut. When the ram and piston are both down, both valves are seated. On moving the piston up, the liquid above presses open the valve, *f*, and flows into the cavity under the piston as it ascends. When the lever is again moved down, this same liquid shuts the valve, *f*, and opens *h*, flowing beneath the ram, and raising it. This jack may be used either vertically or at any angle with the horizontal line. The head must, however, be slightly raised, to induce the fluid to pass the valves.

For the Journal of the Franklin Institute.

On the Collapsing of a Boiler in the Establishment of C. C. Rheinhardt, at Baltimore, Md., on the 2d day of January, 1854. By Wm. H. Shock, Chief Engineer, U. S. N.

A few hours after the above accident, I happened to be in the vicinity of its occurrence, and by permission examined the boilers as far as was practicable, and the results of its collapsing, *i. e.* the demolishment of a three-story brick building, in which was manufactured various surgical instruments, and of which several thousand dollars worth of unfinished work was totally destroyed, or much injured, the upper story being completely shattered or torn to pieces, rendering necessary, in all probability, a renewal of the walls to their foundation. Doors and windows in remote parts of the building were torn from their hinges—*indeed*, all around were strewn frightful evidence (in this case) of a badly managed agent of wealth and power.

The stock in course of completion comprised a large variety of trusses and fine surgical instruments. A valuable collection of tools, turning lathes, forges, &c., were greatly damaged, or rendered entirely useless. But, *most sad* to relate, six of the employees of the establishment were wounded, two of which cases it is supposed will terminate fatally. It is to be hoped, however, that so sad a termination to the unfortunate circumstance will not ensue.

The boilers were of the upright cylindrical type, (with upright tubes,) eleven feet high and four feet diameter. From the condition of the boiler at the time of my examination, it was impossible for me to get an exact sketch. I herewith send one that I think will not prove far from being correct. It will suffice, however, for our present purpose, *i. e.* as a reference in offering a few reasons as to the probable cause of the above

catastrophe. As a general thing, it is next to an impossibility to collect a correct statement of the attending circumstances of an explosion or collapse. I succeeded, however, in obtaining the following facts from the proprietor of the establishment:

"On Saturday evening, December 31st, the work in the establishment was suspended at the usual hour, and steam blown off. On Monday morning following, the man in charge of the machinery, as was his custom, pumped up the boiler, and started fires, and made his arrangement for starting the engine at 7 A. M., the hour for commencing the day's work, *at which time an effort was made to blow the whistle, but for want of steam failed. No effort had been made to start the engine that morning at all. At five minutes after 7, the explosion took place. One of the wounded men had tried the water gauges at 7 o'clock, (five minutes before the explosion,) and found water in No. 2 gauge, there being four gauges on the boiler. The safety valve was screwed down by a spring balance to 65 lbs. per square inch.*"

Here we have in substance the statement of Mr. Rheinhardt, and from which, with an examination of a piece of the fractured part of the boiler, which I have caused to be forwarded to the Institute for its inspection, some useful information may be obtained in regard to this matter.

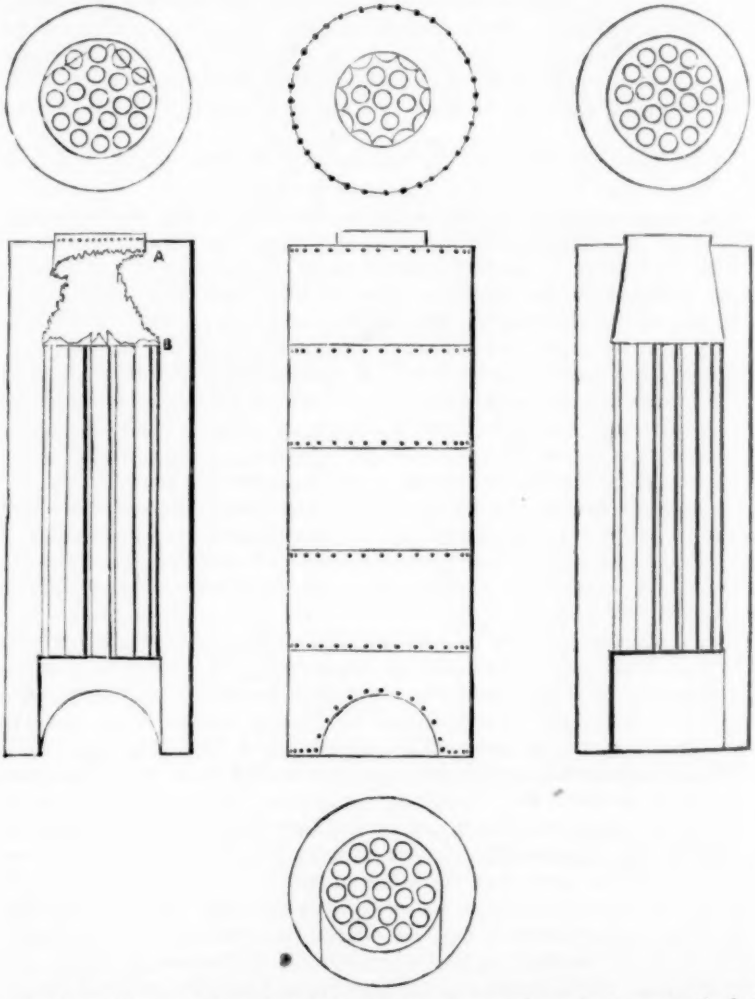
I conclude there is scarcely a doubt as to the fact that the condensed steam collected in the whistle or pipe, or both, had frozen firmly, as it extended above the roof of the building, and was exposed to the cold during Saturday night, Sunday, and Sunday night, and *as it appears his index for the required pressure was to be the blowing of the whistle*, and in waiting for which he committed an error which involves his employer in a serious loss, and perhaps the forfeiture of his own life to his insane proceedings. The safety valve, we are informed, was screwed down to a pressure of 65 lbs. per square inch. Who knows this fact? Mr. R., the unfortunate proprietor, asserts that this was the usual pressure, *but cannot speak advisedly as to the point it was screwed down to on the morning of the collapse;* and although he exonerates his boiler tender from blame in this particular case, yet I am informed by him "*that he was not a careful man as a general thing.*"

The fracture began at or near the top of the boiler, and extended around two-thirds of the circumference of the inner shell, and consequently above the water level, taking a downward direction to the top tube sheet, in a multiplicity of irregular fractures, and finally was crushed down and flattened over each other, and over the upper end of the tubes; and to this fact I attribute such thorough destruction *above the boiler*, as it prevented in a great measure the expanding gases from a downward direction through the tubes, and thence out through the furnace doors. As farther reasons for this disaster, I do not consider the iron to have been of a good quality, as will be seen from the piece submitted. I am also of the opinion it was not thick enough, particularly in the absence of all bracing. About the fractured part, it may be offered that bracing in a cylindrical boiler of these dimensions is unnecessary for a pressure of 65 lbs. per square inch. Well, under certain conditions, I would agree with them, but those conditions would have to be—

1st. The boilers to be made of the best quality of iron, *and not mixed.*

2d. To be of a proper thickness.

3d. The safety valve to be properly loaded, and *made inaccessible not only to the boiler tender, but to the owner himself*, and should be inspected by a competent person at specified times, who should be appointed by law, for I can see no good reason why citizens and their property should not be protected from ignorance or wilful neglect of those in charge of steam boilers in our thronged cities, as well as those whom duty or pleasure may call from their homes on our rivers or across the sea. I consider such protection to their property from accidents such as we have just stated, to be a legitimate subject for the legislators of our State government at least.



In the accompanying sketch it will be observed, as before stated, that the fracture began at or near the top of the boiler, at letter A, and was crushed down on the top tube sheet B.

For the Journal of the Franklin Institute.

Particulars of the Steamer Charles Morgan.

New York.—Hull built by Westervelt & Son. Machinery by Morgan Iron Works. Owners, Harris & Morgan. Intended service, Gulf of Mexico.

HULL.—

Length on deck,	215 feet.
Breadth of beam at midship section,	34 "
Depths of hold,	10 & 17 "
Length of engine and boiler space,	74 "
Draft of water at load line,	9 "
" " " below pressure and revolutions,	7 "
Floor timbers at throats, moulded,	14 inches.
Do. do., sided,	14 "
Distance of frames apart at centres,	28 "
Capacity of coal bunkers, in tons of coal,	200
Masts and rig,	Foretopsail schooner.

ENGINE.—One—vertical beam.

Diameter of cylinder,	5 feet.
Length of stroke,	11 "
Maximum pressure of steam in pounds,	20
" revolutions per minute,	20

BOILERS.—Two—single return flued.

Length of boilers,	29 feet.
Breadth "	10 " 9 inches.
Height " exclusive of steam chimney,	11 " 3 "
Number of furnaces,	6
Length of grate bars,	7 "
Diameter of smoke pipe,	6 " 3 "
Height of smoke pipe,	42 "
Number of flues,	16
Internal diameter of flues,	17½, 17, 16, and 12 "
Heating surface in sq. feet.	5000
Description of coal,	Bituminous.

WATER WHEELS.—

Diameter,	31 feet 3 inches.
Length of blades,	8 "
Depth "	1 " 8 "
Number of blades,	26

Remarks.—Hull strapped with iron braces, $4 \times \frac{5}{8}$ inch.

For the Journal of the Franklin Institute.

The Mineral Contents of the Lower Sandstone of the Upper Mississippi. Condensed from Dr. Owen's Geol. Survey of Wisconsin, &c. By Dr. L. TURNBULL.

According to Dr. Owen's experience in other mining districts, the country over which this light colored quartz ore sandstone prevails, is not likely to be very productive in mineral deposits; yet between the Mississippi and Kickapoo Rivers, on the southeast quarter of Section 27, Township 10, North, Range 5, West, of the 4th Principal Meridian, copper ore has been discovered, not, however, in immediate connexion with the sandstone. The wall-rock to which the ore was traced, and which bounds it on the south-east, is a magnesian limestone, possessing

all the characters usual in the lead and copper localities of the rich Mineral Point district.

This copper ore has a light green color, waxy lustre and fracture, and very brittle, disseminated through ferruginous earthy matter, composed chiefly of brown oxide of iron. The following is the analysis by Dr. Owen, of this ore, in the usual way, gave from a gramme:—

Water,	11·2
Carbonic acid,	05·0
Insoluble silicates, traces of oxide of iron,	08·3
Protoxide of copper,	25·0
Peroxide of iron,	48·7
Protoxide of manganese,	00·2
Alumina,	00·6
Carbonate of lime,	00·8
Loss,	00·2
	100·0

=19·87 per cent. by calculation, of metallic copper.

Smelted by Wm. Preston, at Mineral Point, it yielded 23 per cent. of metallic copper, being only three per cent. more than the result of Dr. Owen's analysis.

This ore was first discovered by a Mr. Sterling, in March, 1843, on the north slope of a hill, the foot of which is watered by Cooper creek, a small tributary which runs west, into the Mississippi, four and a half miles from the Kickapoo. It was explored by Mr. Sterling, and proved to be a bed from 12 to 15 feet wide, and five to seven deep, spreading out as it descended the slope, to 30 feet wide, and conformable to the outline of the hill. On tracing it to the south, it was followed to near the brow of the hill, where it pitches to the southeast, parallel with a wall of magnesian limestone, and almost perpendicularly. The wall of magnesian limestone is quite solid, and without apparent stratification. A shaft of 50 feet was first sunk from the surface; then a drift of 90 feet was run on the west side of the perpendicular wall of rock; and afterwards another shaft of 12 feet at the end of the drift. To the north, a gallery was run 40 feet, and six feet sunk perpendicularly; the copper ore extending both horizontally and vertically, as far as these excavations were carried.

The mine lies well for drainage, and the ore is of a kind easily reduced in the furnace, and yields so good a per centage of copper (about 20 to 23 per cent.) that it would be well worth the expense to prove this mine further than has yet been done, so as to determine to what extent the ore traverses the magnesian limestone before entering the sandstone, in which latter formation the vein would probably dwindle, or entirely disappear. Mr. Sterling has transported 24,000 lbs. of the ore to Mineral Point, and had it smelted, with the results as given above.

Carson & Sterling, of Mineral Point, subsequently discovered copper ore of a similar quality on the same quarter section, only 300 yards north of the ore bed just described.

On Section 1, Township 12, and Range 4, east of the 4th Principal Meridian, copper ore has been found, in the vicinity of the Barraboo River, disseminated in pockets through brown ferruginous beds of sandstone,

occurring towards the base of F 1. It is a green carbonate and silicate of copper, similar in character to that occurring near Mineral Point.—*Owen's Geol. Survey.*

Copper Ore in the Lower Magnesium Limestone.—Between Plum and Pine Creek, in the south west corner of Section 26, Township 8, North, Range 5 West, of the 4th Principal Meridian, on the south east slope of a hill, copper ore, associated with hematite, was found, and traced into a crevice traversing the lower cherty beds of the formation; also four, miles beyond, in a N. N. W. direction, on the slope of another hill, copper ore was picked up, and yielded, by analysis, from 17 to 23 per cent. of copper.

To be Continued.

For the Journal of the Franklin Institute.

Particulars of the Steamer Sonora.

New York.—Hull built by Westervelt & Son. Machinery by Morgan Iron Works. Owners, Pacific Mail Steamship Company. Intended service, Pacific.

HULL.—

Length on deck,	264 feet.
Breadth of beam at midship section,	36 "
Depths of hold,	17 feet 3 in. and 24 " 6 inches.
Length of engine and boiler space,	66 "
Draft of water at load line,	12 "
Draft of water at below pressure and revolutions,	7 "
Floor timbers at throats, moulded,	16 inches,
" " sided,	14 "
Distance of frames apart at centres,	28 "
Masts and rig,	Foretopsail Schooner.

ENGINES.—Two—Vertical beam.

Diameter of cylinders,	50 inches
Length of stroke,	10 feet.
Maximum pressure of steam in pounds,	20
Maximum revolutions per minute,	20

BOILER.—Two—single return flued.

Length of boilers,	30 feet.
Breadth "	13 "
Height " exclusive of steam chimney,	12 "
Number of furnaces,	6
Length of grate bars,	7 "
Number of flues,	28
Internal diameter of flues,	16, 15, 13, and 10 inches.
Diameter of smoke pipe,	6 feet 9 "
Height of smoke pipe,	42 "
Description of coal,	Bituminous.

WATER WHEELS.

Diameter of water wheel,	30 feet.
Length of blades,	9 "
Depth "	16 inches.
Number "	26

Remarks.—Guards fore and aft; hull strapped with iron braces. $4 \times \frac{5}{8}$ inches.

For the Journal of the Franklin Institute.

Particulars of the Steamer Orizaba.

New York.—Hull built by Westervelt & Sons. Machinery by Morgan Iron Works. Owners, Charles Morgan & others. Intended service, Gulf of Mexico.

Hull.—		
Length on Deck,	240 feet	
Breath of Beam,	34 "	8 Inches.
Depth of Hold,	17 "	
Length of Engine and Boiler space,	76 "	
Draft of water at load line,	11 "	
" " below pressure and revolutions,	7 "	
Floor Timbers at throats, molded,		14 "
" " sided,		14 "
Distance of frames apart at centres,		28 "
Masts and Rig	Foretopsail schooner.	
Engine.—One—Vertical beam.		
Diameter of Cylinder,		65 "
Length of Stroke,	11 "	
Maximum pressure of steam,	20 lbs.	
" revolutions,	20 per min.	
Boilers.—Two—Return flued.		
Length of Boilers,	30 "	
Breadth of Boilers,	12 "	
Height of Boilers, exclusive of steam chimney,	15 "	
Number of Furnaces,	6	
Length of Grate Bars,	7 "	6 "
Number of flues,	16	
Internal Diameter of flues,	15, 17½ and 13½ "	
Diameter of smoke pipe,	6 "	9 "
Height of smoke pipe,	42 "	
Fire surface,	4000 "	
Natural draft to furnaces,		
Description of coal,	Bituminous.	
Water Wheels.		
Diameter,	30 "	
Length of Blades,	9 "	
Depth of Blades,	1 "	10 "
Number of Blades,	26	

Remarks.—Hull strapped with iron diagonal and double laid braces, 4 by $\frac{5}{8}$ inches, floors filled in solid.

For the Journal of the Franklin Institute.

Note on the Absolute Elimination of the Flexion of Telescopes. By M. Porro.

[Read before the Academy of Sciences of Paris, 14th November, 1853.]

Taking advantage of the indeterminateness of the problem of achromatism, I introduced into the calculation of the radii of curvature of an object-glass, the condition that the radius of curvature of the fourth surface,

should be equal to the focal length. By this I obtained, by reflexion at the focus, an image of the reflected wires which permits the determination of the point on the optical axis, independent of the figure of the tube; it was then sufficient to connect the alidade circle with the object-glass only; the eye-piece might be placed on a separate support, supplied with the necessary movements, and then the tube plays no part in the determination of the collimation line of the telescope, and there is no longer any occasion to concern ourselves about its flexion.

It will be, perhaps, remembered that on the occasion of the construction of a large equatorial for the Technomathic Institute, I communicated to the Academy, a mode of reducing the flexion to a very small quantity; the leisure left me by the suspension of the work of constructing the equatorial in question, permitted me to obtain this means of annulling it completely; but the work was already too far advanced to apply the new improvement.

I will show, in another memoir, how a purely optical phenomenon, similar to the above, will permit the astronomer to determine, first, without circles or divisions, the absolute directions of the visual rays placed at all apozeniths from 30° to 30°, then to decide optically, by means of an arc of 30° only, the intermediate apozeniths to the small fractions.

The substitution of a purely optical determination for those dependent on the figure and adjustments of the metallic parts, appears to me to be the *nec plus ultra* of the improvements which can, at the present day, be desired in astronomical instruments.

For the Journal of the Franklin Institute.

The Ericsson

Has again actually turned her wheels, and judging from their speed (or rather slowness), has made as many as four or five turns per minute at the wharf. Her owners decided not to take the place of the Humboldt (although they applied for it) as she could not be got ready in time. The getting ready of an Ericsson Air Engine being a job of some magnitude; about four weeks having already been consumed in working up to five revolutions. It may be gratifying to steam engineers to know, that they have a small steam engine on board to fill their receivers, although why a small air engine would not have done the duty, is, to those not in the secret, a puzzle.

P. S.—We observe by the New York papers, that after hauling out in the stream, preparatory to a trial trip, the ship has returned to her dock.

X. Y. Z.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, January 19, 1854.

G. W. Conarroe, Esq., President, P. T., in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations to the Library were received from Prof. E. N. Horsford, Cambridge, and Mass. Charitable Mechanics Association, Boston, Mass.; M. W. Baldwin, and G. H. Hart, Esqrs. Penn. Legislature; The Mechanics Institute, Chicago, Illinois; and Messrs. Lindsay and Blakiston, Blanchard and Lea, and Dr. L. Turnbull Philadelphia.

Donations to the Cabinets from Dr. P. Shumberg, Sarah Furnace, Blair Co. Penna.; W. H. Shock, Esq., Chief Engineer U. S. Navy; and M. B. Smith and C. W. Packer, Esqrs. Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement for December; and also his annual statement for 1853.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Publications reported their annual satement of the condition of the Journal of the Institute.

The Committee on Exhibitions presented printed copies of their report on the late Exhibition.

New Candidates for membership in the Institute (3), were proposed, and those proposed at the last meeting (10), were duly elected.

The Tellers of the annual election for Officers, Managers, and Auditors, for the ensuing year, reported the result, when the President declared the following gentlemen as duly elected:—

Samuel V. Merrick, President.

Thomas Fletcher, } Vice Presidents.
Abraham Miller, }

Isaac B. Garrigues, Recording Secretary.

John C Cresson, Corresponding Secretary.

John F. Frazer, Treasurer.

MANAGERS.

Matthias W. Baldwin,	Isaac S. Williams,	Wm. D. Parrish.
Frederick Fraley,	Henry P. M. Birkinbine,	Frederick Graff,
John Agnew,	George W. Conarroe,	Thos. S. Stewart.
John H. Towne,	Thomas J. Weygandt,	John E. Addicks,
Edwin Greble,	Joseph J. Barras,	John McClure,
David S. Brown,	George N. Eckert,	Jos. Harrison, Jr.
Owen Evans,	Charles E. Smith,	George Erety,
Alan Wood,	John C. Trautwine,	Evans Rogers.

AUDITORS.

Samuel Mason, Algernon S. Roberts,
James H. Cresson.

G. W. Smith, Esq. drew the attention of the meeting to certain errors which he had detected in the experiments of Lieut. Drummond with the lime light in which a Committee of the Trinity House Board and certain members of the Royal Society had assisted. These experiments are contained in the Philosophical Transactions, London, June 17, 1830 vol. cxx, p. 383.

The lime ball, or cylinder, was $\frac{3}{8}$ inches diameter, with two jets of oxygen and hydrogen gas directed on it, the illuminating power was equivalent to 13·5 Argand lamps-$\frac{7}{8}$ inch in diameter, equal only to $6\frac{3}{4}$ such lamps for each jet, as manifestly appears in page 390, nevertheless in the latter part of the same page, the intensity of the lime light is stated at no less than 264·1 of such Argand lamps; now the mode by which this apparent result was obtained, was "by screening the different lights, and then placing *equal* apertures opposite each:" now this was literally placing as it were one of the lights under a bushel, for the aperture being small would permit the whole light from the lime ball to fall upon the screen, while the smallness of the aperture would effectually cut off by far the larger portion of the light emitted by the flame of the large* four wick, Fresnell lamp, the flame of which is nearly four inches in diameter by six in height. Relying on this erroneous mode of measurement, Lieut. Drummond came to the conclusion that the intensity of his lime light, was equal to 264 common Argand lamps, when his own previous experiment conclusively proved it to be equal to only 13·5.

Dr. B. H. Rand, inquired of Mr. Smith the greatest distance at which the Drummond light had ever been seen. A referrence to vol. cxvi of the Philosophical Transactions, page 334, states that it has been seen at the distance of $66\frac{1}{4}$ miles; Dr. R. inquired of Mr. S. the maximum distance at which the Fresnell light had been observed, Mr. S. stated, that the Skerryvore light had been distinctly seen by the unassisted eye, from the Summit of Ben Nevis, a distance exceeding 90 miles.

Mr. Smith mentioned that the number of miles of Railroad completed in the United States, including also such as will be finished in the spring of the present year, was over 18,000, and that a larger amount had been finished in the United States during the last year than in all the world during the same period.

Mr. Fairman Rogers exhibited a model of a cast iron coffer dam, invented by Mr. Joseph Clark, of Pennsylvania. The inventor proposes to use cast iron piles in the formation of the dam, fitting into each other by a species of dovetailed tongue and groove along their sides, and adjustable to different heights, in order to fit the irregularities of a rock bottom, for which it is specially intended. The transverse section of each pile is that of a voussoir of an arch, and when joined they form a circular or segmental dam of a radius adapted to the space to be enclosed.

The pressure of the water on the outside is resisted by the arch formed by these piles.

The joints to be made tight by the use of any very viscous grease.

* This lamp is equal to 17 common Argands.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. McRea's Railroad Drawbridge and Switch Safety Telegraph.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, a "Railroad Drawbridge and Switch Safety Telegraph," invented by Wm. C. McRea, Esq., of Philadelphia, Pennsylvania—REPORT:

That in this contrivance an electrical current is arranged so as to be closed when the drawbridge or switch is in proper position, and to be broken when this is not the case. The wire terminates in a rail carefully insulated from the rest of the track, and at such a distance from the bridge as to allow ample room for stopping the train of cars between them. The next rail to the one spoken of is also insulated from the track, and connected with one of the ground plates of the circuit. On the locomotive is placed an electro-magnet of the ordinary construction, whose keeper controls the works of an alarm, so that the bell, stopped while the keeper is not attracted by the magnet, is released and allowed to ring the moment that this attraction takes place. The wire of the coil terminates in metallic connexion with the front and hinder axles of the locomotive. And it will be easily seen that when the locomotive reaches such a point, that the fore wheels are on one of the insulated rails, and the hind wheels on the other, the electric circuit (provided the drawbridge is closed) is completed through the magnet, and the bell rings, indicating that it is safe to proceed; but if the drawbridge or switch is open, the bell will not ring, for the electric circuit is not closed, and the conductor is warned to stop or to proceed with caution.

The means proposed for obtaining this important end are simple, and not expensive, and the idea is certainly a very ingenious one; and it will be observed that the result of any failure in the apparatus is simply to excite the cautiousness of the conductor. This safety signal cannot be given unless every thing is in order. This constitutes, in the opinion of the Committee, the very great merit of the contrivance. In practice, the difficulties which suggest themselves, will be in perfectly insulating the rails, especially in low situations, and in very wet or icy weather; and, secondly, in arranging the extremities of the magnetic coil so that the current from the wire will pass through them. There can be little doubt that the grease on the well oiled axle of a locomotive will prevent the passage of an electric current of such feeble intensity, and if it did not, it would pass through the pedastals and iron work of the engine to the other axle, and thus escape the magnetic circuit. But the avoidance of this objection will probably be easy; and the simplicity of the apparatus and importance of the result to be obtained, thereby recommend Mr. McRea's invention to a practical trial.*

*As soon as these objections were proposed to the inventor, he suggested a mode of obviating both of them by terminating one end of the magnet coil on a rod projecting downwards from the cow catcher, the other in a rod projecting similarly from the hinder frame of the engine, and setting the insulated rails in the middle of the track, where they can easily be completely insulated.

It would also be advisable that a signal should be given to the switch or bridge tender, to prevent the possibility of his opening the switch or bridge after the engine had passed the signal station, but before reaching the point of danger.

Mr. McRae has also proposed a modification of the apparatus for avoiding the collision of trains on a single track road. At the turn-out at each extremity of the part of the track on which the trains may meet, the insulated rails are prepared as before, but at each point the line is provided with a "circuit changer," as shown in the accompanying drawing; the battery has a double circuit, each including one of these 'circuit changers.'

The ordinary position of the "*circuit changer*" is such that the current to which it belongs is interrupted. Now, the conductor of the train who first arrives at one end of the prepared track, shifts the "*circuit changer*" by a simple motion, and thus passes a current from the distant station through his magnet, and the ringing of the bell indicates that he may proceed in safety. In proceeding, he leaves the *circuit changer* in its new position, by which the circuit at that end is broken. If, now, while he is on the doubtful ground, the other train arrives, and the conductor shifts the *changer* at that end, he can get no circuit, and, consequently, his bell is silent; for it will be seen by the drawing that the current must come from the far station, and that has been thrown out by the first train in passing; he must therefore wait. As the trains pass off the ground they must stop to readjust the *circuit changers* in their first positions. It will be seen here again, that any failure of the apparatus, or negligence in its adjustment, can only produce delay, and that, provided the first conductor performs his duty, a collision is impossible. These changes may, it is manifest, be easily made by the locomotive itself, if that be deemed desirable. The Committee therefore report, that the invention of Mr. McRae appears to present a simple and not expensive means of adding materially to the safety of railroad traveling; and that it is, in their opinion, worthy of trial in practice, which is the only thing which can finally decide upon its utility, and they recommend that a description of the instrument be published in the *Journal* of the Institute.

By order of the Committee,

WM. HAMILTON, *Actuary.*

Philadelphia, October 15th, 1853.

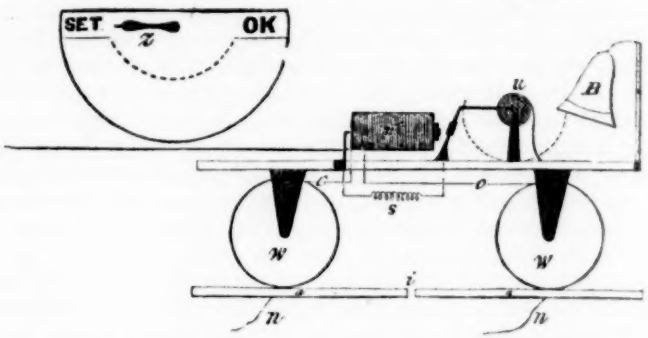
Description by the Inventor.

The mode of arrangement is, to extend a wire from a battery across the drawbridge, to a safe distance on each side, and there connect to an insulated rail in the track.

When a train of cars approaches the bridge from either side, so that the wheels *w w*, fig. 1, touch the track *a a*, at opposite sides of the insulation *i*, if the draw is closed, a circuit will be completed; *n n*, are the wires which extend from the battery and connect with the track; *c c*, are wires which connect the circuit from the wheels to the electro-magnet *m*. When a circuit is formed, the armature *x* will be so attracted as to release the hammer *y*, which will be acted upon by the spring *u* so as to strike the bell B. The shaft to which the hammer is fastened carries with it the hand *z*, as seen upon the index in fig. 2, so that when the circuit is closed the hand will paint to "O K." When the circuit is broken the armature will fall into its former position by aid of the spiral spring *s*,

when the hand of the index is to be turned back to "*Set*," by which the instrument is adjusted for use.

Fig. 2. Fig. 1.



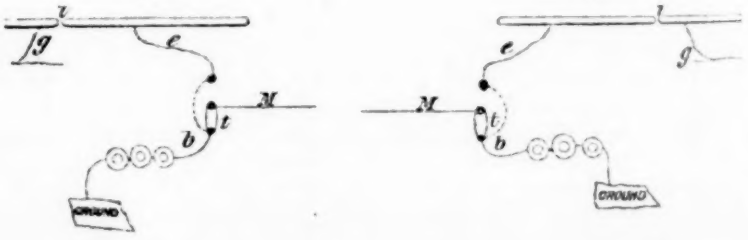
If the draw of the bridge be open when a train approaches it, the circuit will not be completed in consequence of the separation of the wire at the draw; therefore, the bell cannot ring, and the hand on the index will remain pointing to the word "*Set*."

The same plan of galvanic connexions, as also the same instrument, are applicable to the prevention of accidents at railroad switches; as by the displacing of a switch, the same effect may be produced upon the galvanic circuit as by the opening of a drawbridge.

By means of a different plan of connexions, the same apparatus may be used for the purpose of indicating to persons on board of one train as to whether an approaching train has passed a given point of the road or not.

Figures 3 and 4 represent prepared places in the track, as seen in fig. 1; *g* is the ground wire leading from the track on one side of the insulation *i*; *e* is a wire which is attached to the track, opposite the ground wire, and which forms part of the main line; when the "circuit changer" *t* is removed from the battery wire *b*, and placed so as to connect it with the wire M, which extends to the next turn-out.

Fig. 3. Fig. 4.



On the arrival of a train at one of the prepared places, by shifting the circuit changer *t*, from the point where it connects with the battery wire *b*, so as to connect with the wire *e*, a current will be passed through the

magnet upon the car from the battery at the distant station, causing the bell to ring, which indicates that they can proceed in safety. The circuit changer is to be left in its new position, so that when the approaching train arrives at the next turn-out, no circuit can be obtained which indicates that said train must wait.

As the trains pass off the ground, the circuit changers must be placed in the original position.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, an "Improvement in Stereotyping," invented by Jason M. Mahan, of Philadelphia, Pennsylvania—REPORTS

That the improvements claimed are fully set forth in the drawings and specification herewith submitted.

They are twofold; 1st, In the construction of a furnace, in which the metal is melted, the caster for containing the moulds heated, and the plaster moulds dried by the same fire. This arrangement is ingenious and satisfactory, both as regards convenience and economy of time, space and fuel. The most important improvement, however, claimed by Mr. Mahan is in the mode of casting the plates.

In the process of stereotyping, as ordinarily practised, the plaster moulds, taken from the movable type, having been well dried, are placed face downwards upon a cast iron plate, termed the "floater;" this is placed at the bottom of a cast iron tray or "dipping pan," having flaring sides and a lid, which is secured by a screw and clamp; this lid leaves openings at the corners of the tray. The dipping pan having been thoroughly heated before the moulds and floater are put into it, is then immersed in a bath of melted metal, which, entering at the corners of the tray, floats up the floater and moulds. The pan is then taken out, and put upon a water cistern, in such manner as to allow the liquid just to touch the bottom. As the metal shrinks in cooling, more is poured in, and when the whole is cool, the lid is removed, the mass taken out and the metal cast, separated from the plaster and superfluous metal by a mallet, when they are ready for finishing.

In Mr. Mahan's process a caster is employed. This caster consists essentially of an oblong cast iron box, made in four pieces, two ends and two sides, which are ground to fit accurately together, and fastened by screws and bands. It is divided into two equal portions by a transverse vertical partition, pierced near its lower extremity by two small holes.

The plates are arranged vertically in this caster, with the face of one to the back of the other. The caster having been properly heated, the metal is poured in, passing through the holes in the lower part of the central partition, rising on either side, and may be made to flow out of a hole in the end near the top of the plate of the caster, until all moisture and air are removed. The whole apparatus is then placed in a vessel containing water, which reaches a few inches up the inside. When cool, the caster is taken to pieces and the casts separated as in the ordinary process.

The advantages of the improvement may be stated to be—

1st, There being no necessity for immersing the casts and caster in the melted metal, no more metal need be fused and kept so than is necessary to fill the apparatus; thus effecting a considerable saving in fuel and avoiding loss by oxidation.

In one of the experiments witnessed by the Committee, 12 8vo. pages, containing each 4224 ems, in all 50,668 ems, were cast at one operation. The amount of metal in fusion was 50 pounds, and the weight of the plates when separated and dressed was 21 pounds.

2d, From the vertical position of the plates, a large number may be cast at one operation. In the ordinary process two pages 8vo are cast at one dip, and a good workman will make five of these dips in the course of an hour. By the method of vertical casting, the number of pages made at one cast may be readily increased to twenty or more. While the apparatus necessarily requires, from the amount of metal in it, a longer time to cool than the ordinary dipping pan, it is easy, by having several casters, to be filling a second or third while the first is becoming cooled. In this way the number of plates cast in a given time may be greatly increased, while the labor of dipping, removing, and cooling the pan for each successive pair is avoided.

The vertical position of the plaster moulds allows them to be made thinner, thus causing them to dry more rapidly, and enabling the operator to insert a larger number in a caster of given size.

3d, From the weight of metal above the plates and its gradual cooling from below, it has an opportunity of settling into all the hollows in the mass, by which cavities or *blows* are avoided.

4th, As the metal is made to flow through the apparatus, all air and moisture are expelled.

5th, From the simplicity, cheapness, and compactness of the whole arrangement, stereotyping may be performed with a little practice by the printers themselves.

The Committee is aware that attempts have been previously made to cast stereotype plates in the vertical position, but these have been abandoned on account of the difficulty of getting rid of the air and moisture. These difficulties appear to have been removed by the apparatus of Mr. Mahan.

The Committee has on several occasions witnessed the operation of casting by the inventor, and believes the process to possess the advantages claimed for it by him. It has examined the plates carefully; the face appears to be fully equal to that produced by the ordinary process; the texture of the plates on fracture is uniform, showing that no separation of the constituents of the alloy had taken place, and, in the specimens examined by planing, no *blows* were detected. Believing, therefore, that Mr. Mahan has achieved a valuable improvement in an important art, the Committee recommends the award of a first premium for the apparatus on deposit at the last Annual Exhibition, as well as that of a Scott Legacy Medal and Premium for the invention.

By order of the Committee.

WM. HAMILTON, *Actuary.*

Philadelphia, January 12th, 1854.

Description by the Inventor.

Fig. 1, is an elevated view of the caster.

Fig. 2, is a sectional view of the same.

Fig. 3, is a perspective view of a thin plate of iron having projecting sides and bottom.

Fig. 4, is a semicircular plate of iron, used to prevent the moulds from floating.

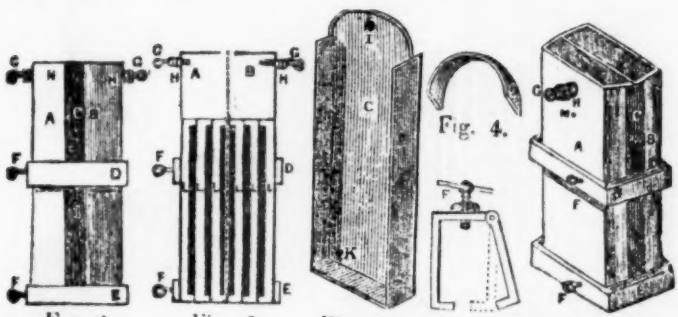


Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6.

Fig. 5, is a band and screw, used to fasten the caster together.

Fig. 6, is a perspective view of the caster when in readiness for operation.

A, in figs. 1 and 2, is one side of the caster as shown by A in fig. 6.

B, in figs. 1 and 2, is the other side of the caster as shown by B in fig. 6.

C, in figs, 1 and 2, is placed between A and B, in the bottom of which are two or more holes, as shown by K in fig. 3; D and E are bands to fasten the caster firmly, having a joint at one corner, for the purpose of removing it with facility, as shown by fig. 5.

F, in figs. 1 and 2, are screws to fasten the bands, as shown by F in fig. 5.

G, in figs. 1 and 2, are two screws, used to fasten down the moulds by screwing against two semicircular plates of iron, as represented by fig. 4.

L, L, L, L, L, L, in fig. 2, are moulds, showing the position they are placed in the caster.

M, in fig. 6, is a hole to let off metal when necessary.

Fig. 7, is a perspective view of the melting pot.

Fig. 8, is a sectional view of the melting pot, and replenishing funnel.

Fig. 9, is a sectional view of the furnace melting pot, replenishing funnel, floater, and drying oven.

Fig. 10, is an elevated view of the furnace when complete.

Fig. 11. is a view of melting pan, cooling vessels, and caster, showing the position in which they are placed when drawing off the metal.

A and A, in fig. 7, are two rods used for drawing off the metal into the caster, as shown by figs. 8, 10, and 11.

B, is the replenishing funnel, having a lid attached, which answers as a covering for a part of the furnace and a tube, through which the metal passes into the melting pot, as shown, by figs. 9, 10, and 11.

c, is a lid which completes the covering of the furnace, as shown by fig. 10.

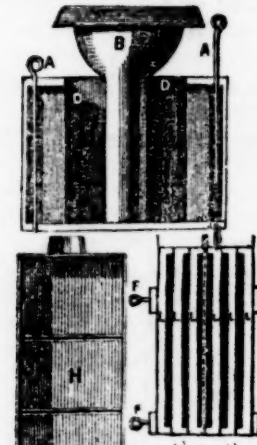


Fig. 8.

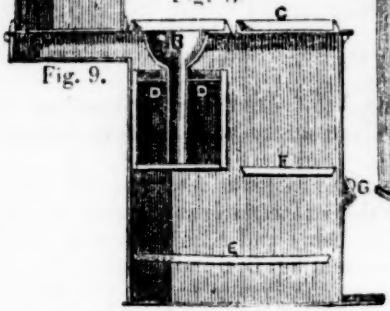


Fig. 9.

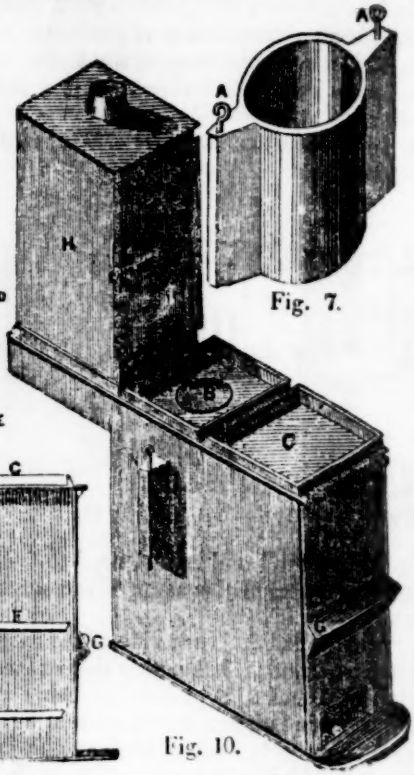


Fig. 7.

Fig. 10.

D, in fig. 8, is a plate of iron floating on the surface of the metal; this excludes the atmosphere and prevents its oxidization.

From the position of the caster in figs. 8 and 11 it will be seen that the metal is drawn into the side B of the caster, flows through the holes K, and passes off at the hole M if necessary. This however is not necessary when the moulds are perfectly dry, but in case they are not, which may be known by their bubbling, it is necessary to let the metal off at M until the bubbling ceases; it now only remains necessary to cool off by pouring water into the cooling vessel to the depth of about one inch. The cooling commences at the bottom, leaving the upper part longer fluid, which gradually settles down, and fills all the vacua which would otherwise take place.

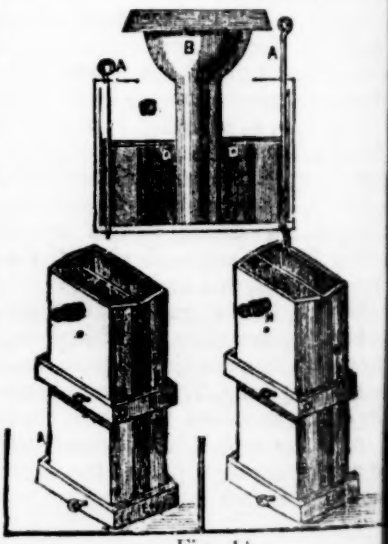
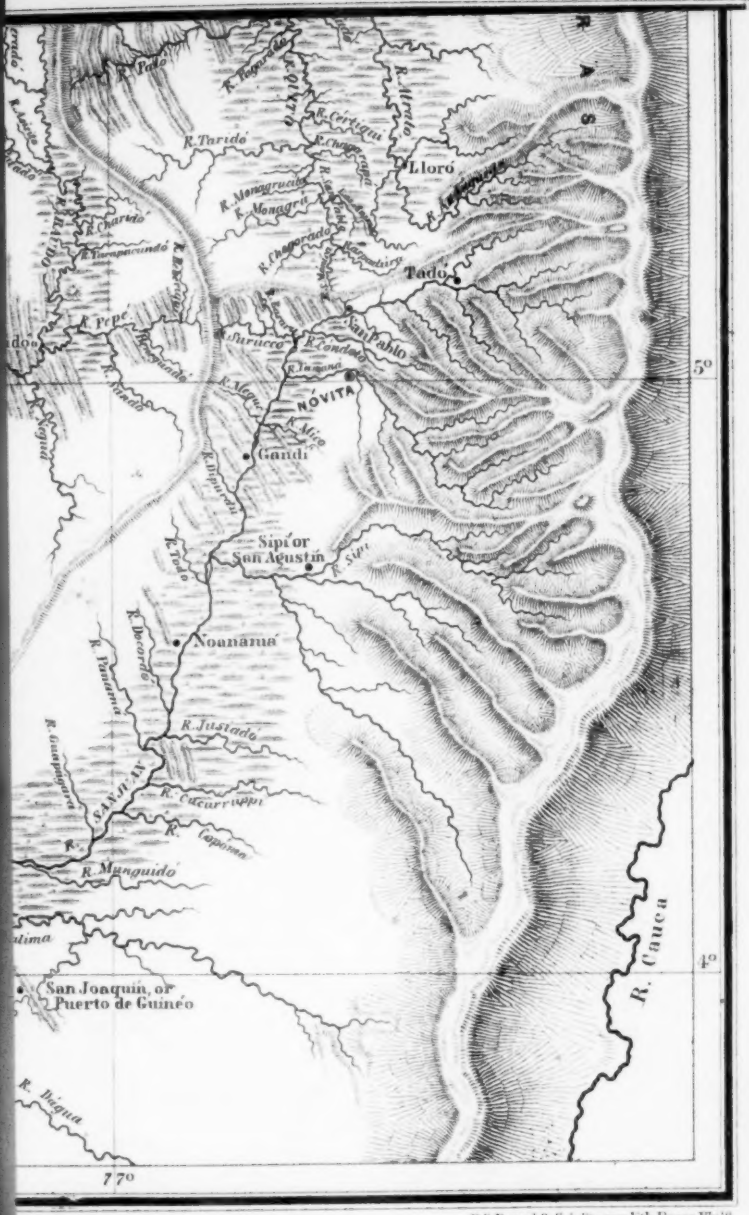


Fig. 11.



P.S.Duval & Co's Steam lith. Press, Phil.a

MAP
OF AN EXPLORATION
for an
INTER-OCEANIC CANAL
BY WAY OF THE RIVERS
ATRATO AND SAN-JUAN
IN NEW GRANADA, S.A.

Laid down from observations made by

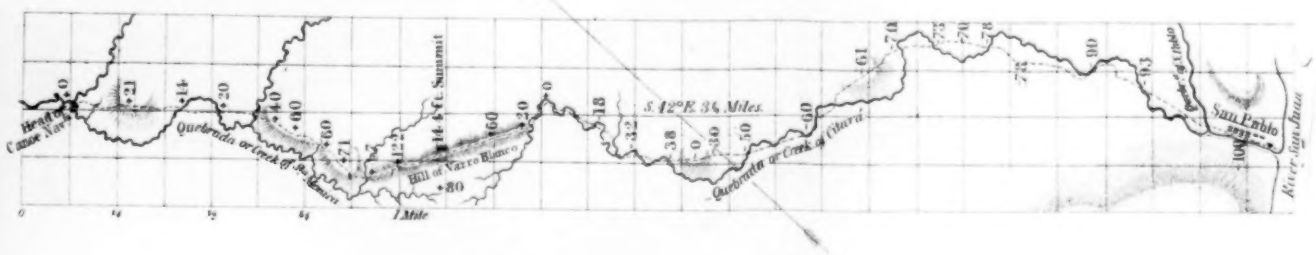
JOHN C. TRAUTWINE, CIV.-ENG.

IN 1852.

NOTE.

The following portions have been protracted from my notes, viz:
The Atrato from its mouth, up to the confluence of the Raspadúra and Santa Mónica, (near its head); except from A to B.
Also the River Baudó, from the confluence of the Heradó, to the Ocean.
Also that portion of the River San Juan which lies between Chirambirá and the River Munguidó.
I merely observed the distances (not the bearings) of the Patò, the Pepé, the Suriácco, and the San Juan from San Pablo to the Munguidó.
The protracted portions exhibit all the bends in the respective streams.
The red lines _____ show my route.
In filling-in the mountains on the Isthmus of Panamá I have merely aimed at exhibiting the General character of the interior as suggested by the appearance from both sides. The height of the principal range appeared to vary between ½ and ¾ of a mile.
The blue line _____ shows the route proposed by myself for a Ship Canal, as preferable to any other, theoretically; but impracticable on account of its cost, which I estimate roughly at $325,000,000.

J. C. T.



ROUTE OF THE LINE OF LEVELS
run across the dividing ground between the head of Canoe navigation on the Santa Monica, (one of the head waters of the Atrato,) and the River San Juan at San Pablo.

The Starting point, or Zero of the levels is at the head of Canoe navigation on the Santa Monica, and the Symbols + and - denote the elevations or depressions above or below that point in feet. The dotted line shows the Indian path across which the levels were run.

79° 78° 77° West from Greenwich

9° 8° 7°

Portobello
Navy Bay
Gulf of San Blas
R. Chepo
Centinela
PANAMÁ
I. of Taboga
Chimán
R. Chimán
Pearl Islands
Bay of San Miguel
R. Darien
Pt Garachine
C A R I B B E A N S E A
Caledonia Bay
Port Escocés
Port Escondido
Cape Tiburón
Pt Carbána
Pt Arena
Pt Savanilla
GULF OF URABÁ OR DARIÉN
Mouths of the Atrato.
Turbo
R. Guácuba or Lidn
Tuyarendó
R. Sucio
R. Domingodo
A
B
Vigia Curbaradór
Murindó
R. Murindó
C. Montanito
R. Opogado
C. Murié
Cupica
R. Napipi
Tentative proposed Ship Canal Route
P A C I F I C O C E A N
W E S T E R

MAP
OF AN EXPLORATION
for an
INTER-OCEANIC CANAL